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SEDIMENTS

Date:
April 28, 2011

Contact:
Steve Garbaciak

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Our ref:
B0064530.00907

Subject:
Former Plainwell Impoundment 2010 Bank Conditions Monitoring Report
Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site

Dear Mr. Borries, Mr. Bucholtz and Mr. Mills:

On behalf of Georgia-Pacific LLC (Georgia-Pacific), please find enclosed the Former Plainwell Impoundment 2010 Bank Conditions Monitoring Report (Monitoring Report), submitted pursuant to Paragraph 15g of the Administrative Settlement Agreement and Order of Consent for Removal Action (AOC) (Docket No. V-W-07-C-863) and Section 5.6.5 of the former Plainwell Impoundment Time Critical Removal Action Final Design Report.

The Monitoring Report provides a description of the banks in the former Plainwell Impoundment Time-Critical Removal Action area, as observed by representatives of the United States Environmental Protection Agency (USEPA), Michigan Department of Natural Resources and Environment (MDNRE), and Georgia-Pacific on multiple occasions through the summer and fall of 2010. The Monitoring Report is the second of a series of annual reports that will be prepared and submitted by Georgia-

Pacific during the three years of bank monitoring and maintenance that will follow the receipt of the Notice of Completion of Work pursuant to Paragraph 77 of the AOC.

A draft copy of the Monitoring Report dated January 26, 2011 was submitted to USEPA in February 2011. In a letter dated April 8, 2011, USEPA submitted comments on the draft Monitoring Report. Those comments have been addressed in the enclosed final Monitoring Report. A summary of the responses to USEPA comments is included below.

USEPA Comment 1: Some of the 2010 transects are truncated when compared to previous years' surveys. An explanation for why the data was collected in this fashion should be explained in the report. Future transect data collections should extend for the length of the previous transects so a full comparison between years' is possible.

ARCADIS Response: Some survey transects were truncated due to high water levels which limited access to near shore areas. Future transects will be collected to the limits established in the 2009 Former Plainwell Impoundment Bank Conditions Monitoring Report. The text of the report will be revised as follows:

> In addition to the visual inspection of the banks, bank profiles were surveyed at 11 permanently-monumented transect locations in May 2010 to compare bank geometry to post-construction conditions (Figure 2). Due to high water levels impeding access to the near shore areas at the time of the survey, some transects were terminated before the toe of slope. All transect locations will be resurveyed in the spring (May/June) of the next two monitoring years (2011 and 2012) during river water levels that will allow the collection of transect data to the limits established in 2009. Future comparisons will present the surveyed cross-section from the previous year overlaid with the new survey data to evaluate changes in bank geometry. Although there is no quantitative performance standard associated with this effort, the comparison of bank geometry over time will be used in combination with the visual inspection and the BEHI results to develop a weight-of-evidence approach to evaluating bank stability.

USEPA Comment 2: Section 4.2, Comparison of Surveyed Banks: Some of the text descriptions in this section appear to be inconsistent with the bank profiles. Some of the bank profiles show erosion between the 2009 and 2010 monitoring events and needs to be more clearly indicated in the text description (e.g. T-2S, T-

4N, T-4S, T-6S). The issue of the truncated profiles plays into limiting the utility of the description.

ARCADIS Response: The report will be revised to make the bank descriptions consistent with the bank profiles and explain which transects did not evaluate the bank toe. Individual bank descriptions will be revised as follows:

- T-2S –This transect is located on the south bank in Removal Area 3B. It appears to be similar to its design with a stable slope to a point between the prism-out 2-year and median water elevations. ~~and some possible sediment buildup on the bank and at the toe of the bank~~. Below this point, some toe erosion can be noted. ~~There is no apparent change in the geometry of the restored bank at this location from 2009 to 2010.~~ This bank is currently characterized as stable.

- T-3N – This transect is located on the north bank in Removal Area 4A. A small amount of erosion may be indicated by the differences between design and survey, but a stable bank slope appears to have established. The bank angle appears to have increased from 2009 to 2010 as some material has eroded. The 2010 transect survey did not extend to the toe of bank to enable an evaluation of the status of the bank toe. This transect is slightly downstream of the bank area that exhibited an increase in bank erosion potential from 2009 to 2010 due to erosion creating a more vertical bank face. The erosion observed does not appear to be affecting the stability of the bank at this location. This bank is currently characterized as stable.

- T-4N – This transect is located on the north bank in Removal Area 5A. The bank at this location currently appears very similar to the geometry observed in 2009. The 2010 survey did not extend to the toe of slope to enable an assessment of its stability. Overall, this bank is currently characterized as stable.

- T-4S – This transect is located on the south bank in Removal Area 4B. The accumulation of sediment at the top-of-bank that was observed in 2009 exhibits some slight erosion and bank steepening. The lower portion of the bank exhibits a stable slope but also shows signs of some lateral erosion. The 2010 survey did not extend to the bank toe to enable an assessment of its stability. Overall, this portion of the bank is remaining stable.

• T-6S – This transect is located on the south bank in Removal Area 7. This portion of the south bank was repaired in 2008 by the addition of rock at the toe and the installation of a coir log at the prism-out 2-year water elevation. The coir log~~, is~~ visible on the cross-section should assist in the accumulation of sediment on the upper portion of the bank. The portion of the bank below the 2-year water elevation has fluctuated since restoration, but is currently at a stable slope. The portion of the bank below the prism-out median water elevation shows some erosion since 2009, but the addition of rock toe protection in this area should stabilize this bank. ~~The coir log should assist in the accumulation of sediment on the upper portion of the bank~~. This bank is currently characterized as stable.

• T-8S – This transect is located on the south bank in Removal Area 9B. Some significant erosion was concluded to be occurring at this location in 2009, as evidenced by the loss of the designed slope and a steepening of the bank angle at the median water level. Therefore, this portion of the south bank was repaired in 2009 by the addition of rock at the toe and the installation of a coir log at the prism-out median water elevation to protect the lower bank shelf. The coir log~~, is~~ visible on the cross-section should assist in the accumulation of sediment on the upper portion of the bank. Following the repair, the portion of the bank immediately below the median water elevation is currently at a stable slope. ~~The coir log should assist in the accumulation of sediment on the upper portion of the bank.~~ This bank is currently characterized as stable.

• T-9N – This transect is located on the north bank in Removal Area 10A. There is no apparent change in the geometry of the restored bank at this location from 2009 to 2010. However, the 2010 survey did not extend to the toe of the bank to enable an assessment of its stability. This bank is currently characterized as stable.

• T-10S – This transect is located on the south bank in Removal Area 10B. The bank appears similar to the 2009 geometry in 2010, but a small amount of loss of material from the bank face is evident in 2010. The 2010 survey did not extend to the toe of bank to enable an assessment of the stability of this area. Overall, this bank is currently characterized as stable.

• T-11S – This transect is located on the south bank in Removal Area 13B. There is no apparent change in the geometry of the restored bank at this

location from 2009 to 2010, except for a small amount of loss of accumulated material at the median water elevation. The 2010 survey did not extend to the toe of bank to enable an assessment of the stability of this area. Overall, this bank is currently characterized as stable.

If you have any questions about this report, please contact me directly. Thank you.

Sincerely,

ARCADIS

Stephen Garbaciak Jr., P.E.
Vice President

Copies (w/enclosures):

James Saric, USEPA
Jeff Keiser, CH2M HILL
Todd Goeks, NOAA
Lisa Williams, USFWS
Garry Griffith, Georgia-Pacific LLC
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Michael J. Erickson, ARCADIS
Martin Lebo, PhD, Weyerhaeuser Company
Richard Gay, Weyerhaeuser Company
Kathy Huibregtse, ENVIRON

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Former Plainwell Impoundment 2010 Bank Conditions Monitoring Report

Georgia-Pacific LLC

April 2011

ARCADIS

Stephen Garbaciak Jr., P.E.
Vice President

Michael J. Erickson, P.E.
SRI/FS Project Coordinator

Former Plainwell Impoundment
2010 Bank Conditions
Monitoring Report

Allied Paper, Inc./Portage Creek/
Kalamazoo River Superfund Site

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Our Ref.:
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April 28, 2011

Table of Contents

Tables

Figures

Attachments

1. Introduction

This *Former Plainwell Impoundment 2010 Bank Conditions Monitoring Report* (Monitoring Report) presents the results of monitoring activities performed in the former Plainwell Impoundment located on the Kalamazoo River in Plainwell, Michigan (Figure 1). Per the Administrative Settlement Agreement and Order of Consent for Removal Action (AOC), Docket No. V-W-07-C-863, dated February 21, 2007 (U.S. Environmental Protection Agency [USEPA] 2007), monitoring is required annually for a period of 3 years to evaluate the status and stability of banks and floodplain areas that were restored following the Time-Critical Removal Action (TCRA) activities completed in fall 2008. The 3-year monitoring period began upon USEPA approval of the *Former Plainwell Impoundment Time-Critical Removal Action Final Construction Completion Report* (ARCADIS 2010) in the letter dated February 29, 2010 (USEPA 2010).

1.1 General

The restoration and monitoring activities described in this Monitoring Report were performed in accordance with the USEPA-approved *Former Plainwell Impoundment Time-Critical Removal Action Design Report* (Design Report) (ARCADIS BBL 2007) and per post-construction monitoring discussions with representatives of USEPA, the Michigan Department of Environmental Quality (MDEQ), the Michigan Department of Natural Resources (MDNR), and the U.S. Fish and Wildlife Service (USFWS) (MDEQ, MDNR, and USFWS are collectively referred to as the Trustees.

1.2 Project Area Description

The former Plainwell Impoundment is located on the Kalamazoo River in Gun Plain and Otsego Townships, downstream of Plainwell, Michigan. It is roughly bounded on the upstream (or southeastern) end by the Main Street Bridge in Plainwell, and on the downstream (or northwestern) end by the former Plainwell Dam (Figure 1).

As described in the Design Report (ARCADIS BBL 2007), when in operation as a hydroelectric facility, the former Plainwell Dam had a head of approximately 13 feet, and impounded water covering an area of approximately 123 acres. The MDNR drew down and partially dismantled the dam in the 1970s and 1980s, and as a result, the remaining sill of the dam had a head of approximately 5 feet and impounded a surface area of approximately 44 acres. The remaining impoundment encompassed approximately 1.9 miles of river, with an average width of 197 feet and an average water depth of 3.7 feet. The channel slope within this reach was approximately 4.6 feet/mile after draw down.

As described in Section 1.2 of the Design Report (ARCADIS BBL 2007), the former Plainwell Impoundment has been the focus of a series of investigations by ARCADIS (formerly known as Blasland, Bouck & Lee, Inc [BBL] and ARCADIS BBL), MDNR, and USEPA since 1993. The results of these investigations formed the basis for the TCRA and delineation of removal area boundaries.

The USEPA determined that the concentrations of polychlorinated biphenyls in the sediments, river bank soils, and floodplain soils of the former Plainwell Impoundment posed an imminent and substantial danger to both human and ecological receptors (USEPA 2007). As a result, the USEPA determined that a TCRA was necessary to address the contamination. After completion of the TCRA, approximately 12,650 feet of banks in the removal areas were graded and stabilized to minimize erosion and to provide a substrate suitable for vegetation restoration.

Banks were stabilized using a combination of sand backfill and either deep-rooted vegetation or river run rock to create stable slopes and control erosion, with topsoil installed as necessary to support revegetation. Vegetation and riparian habitat was established by seeding and planting in three different hydrologic zones. The basis for the design of these zones is described in Section 2.7 of the Design Report (ARCADIS BBL 2007). Native plant species reviewed and approved by MDNR prior to use were installed in habitat restoration areas. Following installation of woody vegetation, saplings were tied to two stakes for support and all species were surrounded with a ring of woody mulch. The majority of the bank backfilling was completed by September 2008. Bank revegetation activities were completed in Removal Areas 1 through 6B in October 2008 and vegetation of the remaining removal areas (Removal Areas 7 through 13) was completed in June 2009.

Temporary access roads have been removed and the underlying ground was restored by removing the road material and fabric, disking the ground surface to un-compact the topsoil, and seeding with the upland seed mix to restore vegetation.

Kalamazoo River flows at the Comstock gage exceeding the 2-year storm event (2,940 cubic feet per second [cfs] [MDEQ 2007]) occurred in September 2008 (9-day duration with 5,660 cfs maximum flow, approximately a 25-year storm flow based on communication with MDEQ [MDEQ, pers. comm. 2009]), December/January 2008-2009 (3-day duration with a 3,370 cfs maximum flow), February 2009 (4-day duration with a 3,320 cfs maximum flow), and March 2009 (7-day duration with a 4,580 cfs maximum flow). Banks and riparian habitats observed to be stable after these storm events can be concluded to be stable. Restored banks that showed signs of erosion were further evaluated to determine the need for adaptive management or

bank repair activities. Bank repairs required in 2010 were discussed with USEPA and the Trustees and are summarized in Section 5.3.

1.3 Monitoring Program

In accordance with the AOC and as detailed in the Design Report (ARCADIS BBL 2007), monitoring of the restored banks is required to be performed for 3 years. This Monitoring Report discusses data collected in May and July 2010 to satisfy the spring and summer annual monitoring requirements. The 2010 monitoring program consisted of the following activities:

- Visual inspections and evaluations of bank conditions,
- Instrument topographic survey of bank profiles at 11 permanently benchmarked locations,
- Quantitative assessment of bank stability using the Bank Erosion Hazard Index (BEHI) developed by Rosgen (2006),
- Woody plant stem density assessment,
- Quantitative evaluation of herbaceous vegetative cover, and
- Quantitative evaluation of invasive weed presence.

1.4 Document Organization

This Monitoring Report is organized into seven sections, consisting of this introductory section (Section 1) and the following six sections:

- Section 2 - Performance Standards. Presents the performance standards that were established to evaluate the success of the restored areas.
- Section 3 - Monitoring Methodology. Summarizes the methods that were used to perform the annual monitoring activities.
- Section 4 - Monitoring Results. Presents the results of the 2010 spring monitoring efforts and compares the results to the established performance standards.
- Section 5 – Maintenance. Describes adaptive management or maintenance activities that are being proposed for completion in 2010 and 2011 to assist in achieving the performance standards.
- Section 6 - Future Monitoring and Reporting Activities. Summarizes future monitoring and reporting activities.
- Section 7 - References.

2. Performance Standards

Preliminary monitoring requirements and performance standards were developed during the preparation of the Design Report (ARCADIS BBL 2007). Performance standards are quantitative measures that are used to evaluate bank stability and vegetation survival and development. The performance standards used to evaluate the stability and development of the restored banks are described in the following subsections.

2.1 Herbaceous Ground Cover

The herbaceous ground cover performance standard requires that at least 85% of the ground surface be covered by vegetation by the third growing season. Restored banks in the project area were seeded with seed mixes appropriate for the hydrologic conditions present in zones exhibiting frequent inundation (Zone 1), infrequent inundation (Zone 2), or upland (Zone 3) conditions. Zone 1 was seeded and planted with live woody stakes. Zones 2 and 3 were seeded and planted with a variety of tree and shrub species adapted to the hydrologic conditions in which they were planted. The percent cover evaluation methodology utilizes percent cover data collected from randomly-located standardized sampling quadrats, as discussed in Section 3 of this Monitoring Report. Meeting or exceeding the 85% ground cover performance standard indicates that the vegetation will be self-sustaining. If the 85% ground cover performance standard is not met before the end of the third monitoring year and it is determined that the vegetation is not developing adequately to meet this performance standard by the third growing season, maintenance activities may be implemented, as discussed in Section 5.4 of this Monitoring Report.

2.2 Woody Stem Density

The woody stem density performance standard is related to the survival and natural recruitment of native woody trees and shrubs. Trees and shrubs of various sizes were planted in Zones 2 and 3 that supported woody vegetation prior to disturbance during the TCRA. Planting density reflected densities observed during pre-disturbance characterization activities and consisted of 125 shrubs and 50 trees per acre in Zone 2 and 225 shrubs and 75 trees per acre in Zone 3 to create the desired community. The performance standard for woody vegetation is the establishment of at least 85% of the total number of trees and shrubs originally planted by the third growing season. The methodology for determining the quantity of trees and shrubs present in restored areas is discussed in Section 3.4 of this Monitoring Report. Naturally recruited native tree and shrub species that become established in the project area are counted for comparison to the original stem density as they are positive indicators that appropriate environmental conditions have been established for the desired plant community. If

85% of the number of originally planted trees and shrubs do not become established by the third growing season, adaptive management maintenance activities will be implemented to improve the vegetative community, as discussed in Section 5.4 of this Monitoring Report.

2.3 Bank Functionality in Restored Areas

Quantitative performance standards were not established to evaluate bank stability. The amount of bank armoring incorporated into the bank restoration design considered concerns about limiting bank use by wildlife if too much armor were present. The degree of armoring is less than would be included in standard channel design (Rosgen 2006) if wildlife issues were not considered, and reduces the ability to state affirmatively that the banks are completely protected against all reasonably possible mechanisms of erosion-related failure. However, the armor design considered stretches in the project area where erosion protection needs are low, or where some bank erosion may be acceptable. Therefore, the objective of bank monitoring activities is to evaluate the functionality of restored river banks towards the overall stability of the river system, its floodplain, and its associated riparian habitat. The overall stability of the river system and floodplain requires a stable planform, pattern, and dimension, which are evaluated by the monitoring transects and BEHI evaluation. The functionality of the riparian habitat is based on the development of the desired plant communities, which are evaluated by vegetation monitoring and metrics. Monitoring objectives do not focus on whether or not erosion is occurring, but on whether any erosion is jeopardizing the stability of the river system or its top-of-bank land uses. Lateral erosion associated with natural river processes that increase the interaction of the Kalamazoo River with its floodplain are considered acceptable. However, vertical erosion behind bank or toe rock protection that could result in significant bank failure will be addressed through an adaptive management approach.

The stability and acceptability of restored banks are determined based on visual inspections and quantitative evaluations. Discussions of visual evaluations and the use of the BEHI to evaluate temporal changes in bank condition are presented in Section 3.

3. Monitoring Methodology

The following sections describe the specific methodologies that were used to monitor restored banks.

3.1 Visual Bank Inspection

During bank inspection, restored banks were inspected for signs of erosion that would jeopardize the stability of the banks or their functionality in the river system. The limits of a "bank" extend from the toe-of-slope to the first visually observable break in slope. Signs of significant erosion include toe erosion causing undercutting, lateral erosion above the rock protection, exposed geotextile fabric, or vertical erosion down the face of the bank from overland flow entering the river. Stability was evaluated by visual observation and comparison to design drawings, considering location in the river, physical dimensions, and consistency with adjacent, undisturbed banks. The Design Report (ARCADIS BBL 2007) specifies that at least one bank monitoring event be performed after the bank has been exposed to a 2-year, or greater, storm event. A 2-year, or greater, flood represents a high-stress exposure for restored banks and presents a relatively high potential for bank failure.

The visual bank inspection was performed on May 17 and 18, 2010 and consisted of inspecting bank conditions, photographing the banks, and recording conditions of note, including:

- Obvious signs of gullying or rill erosion
- Bank undercutting
- Signs of sloughing (i.e., cracking or bulging visible at the surface)
- Loss of armoring materials (i.e., loss of stones, erosion control matting, and/or vegetation)
- Any obvious signs of lateral bank movement (i.e., due to erosion or deposition)

3.2 Topographic Survey

In addition to the visual inspection of the banks, bank profiles were surveyed at 11 permanently-monumented transect locations in May 2010 to compare bank geometry to post-construction conditions (Figure 2). Due to high water levels impeding access to the nearshore areas at the time of the survey, some transects were terminated before the toe of slope. All transect locations will be resurveyed in the spring (May/June) of the next two monitoring years (2011 and 2012) during river water levels that will allow the collection of transect data to the limits established in 2009. Future comparisons will present the surveyed cross-section from the previous year overlaid with the new survey data to evaluate changes in bank geometry.

Although there is no quantitative performance standard associated with this effort, the comparison of bank geometry over time will be used in combination with the visual inspection and the BEHI results to develop a weight-of-evidence approach to evaluating bank stability.

3.3 BEHI Ranking

The third component in the bank monitoring methodology utilizes the BEHI developed by Rosgen (2006). The BEHI integrates information regarding the relationship of the top-of-bank height to the bankfull water elevation, the vertical extent of root penetration in the bank, the root density, the bank angle, and the percentage of bank surface protected by vegetation or armor to identify a qualitative erosion hazard ranking of “very low”, “low”, “moderate”, “high”, “very high”, or “extreme” (Table 1). BEHI data were collected in May 2010 along restored bank areas and, based on the BEHI ranking resulting from the collected data, each section of bank was assigned an erosion hazard potential classification. The lengths and locations of the erosion hazard classifications establish the baseline for future comparisons. Each monitoring year, BEHI data will be collected and each restored section of bank will be assigned a ranking. A comparison of the BEHI rankings over the monitoring period will indicate trends in bank stability and may assist in identifying problem bank areas.

3.4 Vegetation Monitoring

Areas of restored vegetation were monitored and the percent cover and stem densities compared against performance standards to evaluate the development of the desired plant communities. Woody vegetation monitoring was performed on May 17 and 18, 2010 and herbaceous vegetation monitoring was performed on July 20 and 21, 2010. Future inspections may be performed during drought or flood conditions that could significantly affect the survival of planted vegetation.

3.4.1 Woody Stem Density

The counting of trees and shrubs in the restoration areas was performed in May, when the herbaceous vegetation was still low enough to allow for easy observations of trees and shrubs. The tree count was performed by inspecting the restored portions of the project area planted with trees and shrubs and counting all live native trees and shrubs in the planting areas. The number of observed woody plants was compared to the number of trees and shrubs originally planted to determine the percentage of the original planted stem density that currently exists in the planting area.

3.4.2 Herbaceous Vegetation

The summer annual monitoring inspection consisted of the collection of herbaceous ground cover data during the peak growing season to assess the health and development of herbaceous vegetation restored by seeding. Visual assessment of the total percent ground cover and the relative percent ground cover of all identifiable species was collected from 1-meter-square plots located randomly throughout restored habitats at a frequency of 10 plots per acre. The mean percent ground cover of all of the data plots was compared against an 85% ground cover performance standard that must be met by the third growing season.

Implementation of an exotic/invasive species control program is one part of a successful revegetation program. Species to be monitored for the project area include exotic/invasive species and other aggressive species with a tendency to develop into mono-cultures, such as broad-leaved cattail (*Typha latifolia*), common reed (*Phragmites australis*), multiflora rose (*Rosa multiflora*), purple loosestrife (*Lythrum salicaria*), reed canary grass (*Phalaris arundinacea*), autumn olive (*Elaeagnus umbellata*), garlic mustard (*Alliaria petiolata*), and yellow iris (*Iris pseudacorus*). Control of exotic/invasive species may be accomplished through the physical removal of specimens, or through broadcast or spot spraying of glyophosphate herbicide, such as Rodeo®, by a licensed applicator. Initial exotic/invasive species control was performed concurrently with restoration activities. Additional weed control activities that may be required over the monitoring period will be discussed with USEPA and the Trustees.

4. Monitoring Results

Bank inspection and survey activities were performed in May 2010. The cross-sections of the restored banks at the 11 permanent transects identified on Figure 2 are presented on Figures 3 through 10. The BEHI data are summarized in Table 2 and the erosion hazard rankings for the restored banks are presented on Figure 11. The following sections summarize the results of the BEHI calculations, the surveyed transect comparisons, and the vegetation monitoring.

4.1 Bank Erosion Hazard Index Rankings

Restored banks for the entire length of the project area were assigned BEHI rankings in 2009 based on bank characteristics observed in the field. Each length of bank that exhibited similar characteristics to a previously-characterized length of bank was assigned the same alphabetical label (A through O) in the field.

BEHI rankings were re-evaluated for each bank area based on observed field characteristics in 2010. Photographs of the restored banks representing various BEHI categories are presented in Attachment 1. Table 2 summarizes the changes in bank classifications from 2009 to 2010. Reductions in bank erosion potential are highlighted in green and increases in bank erosion potential are highlighted in red on Table 2. Changes in BEHI ratings for specific restored bank areas are discussed below.

A portion of the north bank upstream of the former Plainwell Dam had been regraded immediately prior to bank inspection activities in 2009. As a result of the grading activities, there was no vegetation to provide surface protection for the bank, which resulted in this portion of the bank (Labeled as E1 on Figure 11) receiving a high bank erosion hazard ranking in 2009. In 2010, the bank was fully re-vegetated, which resulted in deeper and denser root systems and 75% surface protection by vegetation. These new characteristics decreased the BEHI rating of this portion of bank from High to Moderate.

In 2009, the entire north bank upstream of the US-131 bridge was rated as Very Low bank erosion potential due to low bank angles, densely rooted vegetation, and a high percentage of bank surface protection from either rock or vegetation. In 2010, a 270-foot portion of the north bank upstream of the US-131 bridge (Labeled I2 East on Figure 11) exhibited some toe erosion below the waterline to create a vertical bank. This high bank angle and the erosion of vegetation that previously provided surface protection resulted in an increase in the BEHI rating for this portion of the bank from Very Low to Moderate. The remainder of the vegetation on the bank above the waterline was dense and well-rooted and exhibited a shallow bank angle. No repairs were performed in this portion of the north bank, and the 2010 inspection found the

area to be in a similar state, with no additional erosion observed. The addition of a transect at this location was discussed with the Trustees and it was concluded that a new transect would be established and surveyed to better track the stability of the bank in the center of the area that exhibited an increase in the BEHI rating in 2009. The new transect will be surveyed in 2011.

In 2009, a portion of the south bank upstream of the former Plainwell Dam at the former locations of Removal Areas 8B and 9B were concluded to require repair due to excessive erosion. The repairs implemented in fall 2009 consisted of placing river run rock from the remaining top-of-bank shelf to the river bed at an approximate 2:1 (horizontal:vertical) slope. The rock placement was similar to the bank repair performed in Removal Area 7, where rock was placed using a long reach excavator from the south bank. In addition to the rock toe protection, the remaining portions of the shelf behind (landward) the rock were provided additional erosion protection by the installation of a coir log at the prism-out median water elevation, which is the interface of the rock toe protection and the shelf. The coir log is functioning to reduce the flood frequency to allow the establishment and protection of vegetation on the shelf to further stabilize the shelf. This repair resulted in an increase in surface protection which decreased the BEHI rating for the repaired portion of bank (Labeled J2 on Figure 11) from Moderate to Low.

The portion of the south bank immediately upstream of the US-131 bridge (Labeled J1 on Figure 11) exhibited denser and deeper-rooted vegetation in 2010 than was observed in 2009. In addition, the bank angle in this area flattened from 69^0 to 60^0. These improved characteristics decreased the BEHI rating for this section of bank from Moderate in 2009 to Low in 2010.

The south bank (Labeled N1 on Figure 11) downstream of the US-131 bridge exhibited a High bank erosion potential rating in 2009. In 2010, this bank was again rated as High erosion potential, but the increased vegetation density and the decreased bank angle observed in 2010 indicate that this bank area is starting to become more stable.

The BEHI ratings for 2010 resulted in a decrease in the length of bank rated as Very Low erosion potential from 53% (6,770 feet) to 51% (6,500 feet); an increase in the length of bank rated as Low erosion potential from 26% (3,238 feet) to 38% (4,838 feet); a decrease in the length of bank rated as Moderate erosion potential from 17% (2,087 feet) to 6% (807 feet); and a slight decrease in the length of bank rated as High erosion potential from 4% (555 feet) 4% (505 feet). As shown on Figure 11, the single bank area with High erosion potential is associated with Removal Area 6B on the south bank downstream of the US-131 Bridge. Bank areas with Moderate erosion potential were identified on the south bank immediately

downstream of the US-131 Bridge (Removal Area 6B), on the north bank immediately upstream of the former dam (Removal Area 13A), in small areas upstream and downstream of the regraded gas pipeline (Removal Areas 11A), and the new area on the north bank upstream of the US-131 bridge. In general, the majority of the restored banks appeared to be stable following visual inspection, with good vegetation establishment and minimal erosion. All banks with rock protection were stable and filling in with vegetation. Banks without rock protection exhibited varying characteristics. These results indicate an overall improvement in bank stability, except for the area on the north bank upstream of the US-131 bridge. This area will continue to be evaluated for evidence of continuing erosion or increased stability during future monitoring activities.

Lastly, a small area on the top of south bank north of the former staging area and access road was observed to have collapsed. It was not apparent whether the collapse was the result of a subterranean burrow, or runoff from the access road into the river. Following inspection by the Trustees, the repair of this bank was discussed and a repair plan was developed and implemented in 2010. The repair for this bank area consisted of backfilling and seeding as discussed in Section 5.3 of this Monitoring Report.

4.2 Comparison of Surveyed Banks

Eleven permanent bank cross-section locations were benchmarked in 2009 to enable annual replication of the cross-sections to evaluate stability or rate of erosion. The locations of the 11 transects are shown on Figure 2. Detailed bank survey data collected immediately following the physical restoration of the bank in 2009 and in spring 2010 are presented on Figures 3 through 10. Brief descriptions of the observations from these comparisons are presented below.

- T-1N – This transect is located on the north bank in Removal Area 1. The bank at this transect location exhibits a stable slope and possible sediment accumulation since initial construction. There is no apparent change in the geometry of the restored bank at this location from 2009 to 2010. This bank is currently characterized as stable.
- T-2N – This transect is located on the north bank in Removal Area 3A. Similar to transect T-1N, T-2N appears stable with a slope similar to design and some potential sediment accumulation at the toe-of-slope since initial construction. There is no apparent change in the geometry of the restored bank at this location from 2009 to 2010. This bank is currently characterized as stable.
- T-2S – This transect is located on the south bank in Removal Area 3B. It appears to be similar to its design with a stable slope to a point between the prism-out 2-year and median

water elevations. Below this point, some toe erosion can be noted. This bank is currently characterized as stable.

- T-3N – This transect is located on the north bank in Removal Area 4A. A small amount of erosion may be indicated by the differences between design and survey, but a stable bank slope appears to have established. The bank angle appears to have increased from 2009 to 2010 as some material has eroded. The 2010 transect survey did not extend to the toe of bank to enable an evaluation of the status of the bank toe. This transect is slightly downstream of the bank area that exhibited an increase in bank erosion potential from 2009 to 2010 due to erosion creating a more vertical bank face. The erosion observed does not appear to be affecting the stability of the bank at this location. This bank is currently characterized as stable.
- T-3S – This transect is located on the south bank in Removal Area 4B. Current conditions indicate slight erosion, but the maintenance of a stable bank slope. The erosion observed does not appear to be affecting the stability of the bank at this location. This bank is currently characterized as stable.
- T-4N – This transect is located on the north bank in Removal Area 5A. The bank at this location currently appears very similar to the geometry observed in 2009. The 2010 survey did not extend to the toe of slope to enable an assessment of its stability. Overall, this bank is currently characterized as stable.
- T-4S – This transect is located on the south bank in Removal Area 4B. The accumulation of sediment at the top-of-bank that was observed in 2009 exhibits some slight erosion and bank steepening. The lower portion of the bank exhibits a stable slope but also shows signs of some lateral erosion. The 2010 survey did not extend to the bank toe to enable an assessment of its stability. Overall, this portion of the bank is remaining stable.
- T-5N – This transect is located on the north bank in Removal Area 6A. The current general geometry of the bank at this location remains similar to design and to the geometry observed in 2009. Some material appears to have eroded from the mid-bank region, but the bank appears to be stable.
- T-5S – This transect is located on the south bank in Removal Area 6B. There is no apparent change in the geometry of the restored bank at this location from 2009 to 2010, except for some slight erosion at the bank toe. The bank at this location appears to be stable.
- T-6S – This transect is located on the south bank in Removal Area 7. This portion of the south bank was repaired in 2008 by the addition of rock at the toe and the installation of a coir log at the prism-out 2-year water elevation. The coir log, visible on the cross-section, should assist in the accumulation of sediment on the upper portion of the bank. The portion

of the bank below the 2-year water elevation has fluctuated since restoration, but is currently at a stable slope. The portion of the bank below the prism-out median water elevation shows some erosion since 2009, but the addition of rock toe protection in this area should stabilize this bank. This bank is currently characterized as stable.

- T-7S – This transect is located on the south bank in Removal Area 8. A significant amount of erosion was observed to be occurring at this location in 2009, as evidenced by the loss of the designed slope and a steepening of the bank angle in 2009. Therefore, this portion of the south bank was repaired in 2009 by the addition of rock at the toe and the installation of a coir log at the prism-out median water elevation to protect the lower bank shelf. The coir log is visible on the cross-section. Following the repair, the portion of the bank below the median water elevation is currently at a stable slope. The coir log should assist in the accumulation of sediment on the upper portion of the bank. This bank is currently characterized as stable.
- T-8N – This transect is located on the north bank in Removal Area 9A. There is no apparent change in the geometry of the restored bank at this location from 2009 to 2010. This bank is currently characterized as stable.
- T-8S – This transect is located on the south bank in Removal Area 9B. Some significant erosion was concluded to be occurring at this location in 2009, as evidenced by the loss of the designed slope and a steepening of the bank angle at the median water level. Therefore, this portion of the south bank was repaired in 2009 by the addition of rock at the toe and the installation of a coir log at the prism-out median water elevation to protect the lower bank shelf. The coir log, visible on the cross-section, should assist in the accumulation of sediment on the upper portion of the bank. Following the repair, the portion of the bank immediately below the median water elevation is currently at a stable slope. This bank is currently characterized as stable.
- T-9N – This transect is located on the north bank in Removal Area 10A. There is no apparent change in the geometry of the restored bank at this location from 2009 to 2010. However, the 2010 survey did not extend to the toe of the bank to enable an assessment of its stability. This bank is currently characterized as stable.
- T-9S – This transect is located on the south bank in Removal Area 10B. The bank appears similar to the geometry observed in 2009, but some loss of material from the bank face is indicated in 2010. This bank is currently characterized as stable.
- T-10N – This transect is located on the north bank in Removal Area 12A. There is no apparent change in the geometry of the restored bank at this location from 2009 to 2010. This bank is currently characterized as stable.

- T-10S – This transect is located on the south bank in Removal Area 10B. The bank appears similar to the 2009 geometry in 2010, but a small amount of loss of material from the bank face is evident in 2010. The 2010 survey did not extend to the toe of bank to enable an assessment of the stability of this area. Overall, this bank is currently characterized as stable.
- T-11N – This transect is located on the north bank in Removal Area 13A. The bank at this location appears to have lost some accumulated material at the median water elevation resulting in a geometry that is more similar to the design section. This bank is currently characterized as stable.
- T-11S – This transect is located on the south bank in Removal Area 13B. There is no apparent change in the geometry of the restored bank at this location from 2009 to 2010, except for a small amount of loss of accumulated material at the median water elevation. The 2010 survey did not extend to the toe of bank to enable an assessment of the stability of this area. Overall, this bank is currently characterized as stable.

4.3 Vegetation Monitoring

4.3.1 Woody Vegetation Monitoring

The evaluation of the number of woody plants present in the restored habitats was conducted on May 17 and 18, 2010. The results of the stem count are summarized in Table 3. As shown, a total of 3,810 plants were planted in the project area and 3,282 stems were counted in 2010, resulting in 86% of the original planted stem count being present. The overall 86% stem density currently meets the 85% performance standard that must be met by the third growing season.

Stem densities were further evaluated based on geographical locations. The project area was segregated into four geographic zones: north bank upstream of the US-131 Bridge, north bank between US-131 Bridge and the former Plainwell Dam, south bank upstream and downstream of the US-131 Bridge, and south bank upstream of the former Plainwell Dam. As shown on Table 3, the 85% stem density performance standard was met in three of the four geographic areas, but was not met on the north bank between the US-131 Bridge and the former Plainwell Dam. A stem density of 36% was recorded in the north bank between the US-131 Bridge and the Plainwell Dam. The need for additional tree and shrub plantings in this area was discussed with USEPA and the Trustees during the collaborative site inspection in July 2010. The decision to replant larger trees in select locations is discussed in Section 5.2 of this Monitoring Report. Stem density throughout the restoration area will be re-evaluated in 2011.

4.3.2 Herbaceous Vegetation Monitoring

Herbaceous vegetation monitoring was performed on July 20 and 21, 2010. Select photographs of vegetation in the removal areas are presented in Attachment 2. A total of 116 sample plots were randomly distributed throughout the restored areas to represent the herbaceous vegetative community. The total percent ground cover of each plot and the percent cover of each identified species in the plot were recorded and are presented on a removal area-specific basis in Attachment 3. The average percent cover of all plots was 99%, as summarized in Table 4. This result indicates that the applied seed mixes were appropriate for the conditions in which they were applied. Although the 85% ground cover performance standard does not have to be met until the third growing season, it is being met in the second growing season. The herbaceous vegetation will continue to be monitored for 2 more years to verify that the performance standard is met. The restored herbaceous vegetation does not require any maintenance at this time. However, some weed control maintenance activities will be implemented in spring 2011, as discussed in Section 5.1 of this Monitoring Report.

5. Maintenance Activities

5.1 Weed Control

During the 2010 spring inspection, several patches of reed canary grass were observed in restored habitat areas, and previously submerged nearshore areas on the north bank upstream of the former Plainwell Dam were observed to be dominated by reed canary grass. Rather than let the grass go to seed and continue to spread through the restored areas, the reed canary grass was treated in June 2010 with an herbicide to control it early in the growing season. The effectiveness of the treatment was verified during the summer monitoring event, but the nearshore areas on the north bank upstream of the former dam exhibited very little live vegetation because it was unable to be backfilled with topsoil and seeded due to its prolonged period of inundation. Therefore, the nearshore portions of Removal Areas 12A and 11A will be covered with topsoil and seeded with the Zone 1 Seed Mix in spring 2011. The status of weeds in the restored areas will continue to be evaluated during future spring and summer inspections and maintenance activities will be implemented, as required, to address excessive exotic/invasive species.

A portion of the restored habitat on the north bank at Removal Areas 11A and 12A was found to have developed into a monoculture stand of great ragweed (*Ambrosia trifida*). Although ragweed is not a weed specifically identified as requiring control, the density and height of the ragweed negatively affected the survival of trees and shrubs that were planted in the area. The area was reportedly historically dominated by great ragweed and discussions with the Trustees resulted in the conclusion that trying to eradicate the ragweed and establish woody vegetation would be a difficult task with a high likelihood of failure. Therefore, the decision made with the Trustees was to focus maintenance weed control and replanting efforts in the areas surrounding the ragweed to optimize conditions for woody plant establishment and to inhibit the spread of the ragweed. Some weed control by herbicide application may be implemented in spring 2011 to create a buffer between the ragweed and the focused maintenance area surrounding the ragweed. The planting of trees and shrubs in the focused maintenance area is discussed in Section 5.2 of this Monitoring Report.

The results of 2010 herbaceous vegetation monitoring efforts identified an average of 6.4% cover by invasive weeds in the restoration areas, ranging from 0% to 36.7% (Table 4), with reed canary grass being the dominant weed observed (See Attachment 3). Restoration areas with 20% or greater weed cover (6B, 9B, 11A, and 12A, except the ragweed monoculture) will be targeted for herbicide treatment in spring 2011.

5.2 Tree and Shrub Planting

A stem density of 36% was recorded in the north bank between the US-131 Bridge and the Plainwell Dam. Specifically, portions of Removal Areas 13A, 12A, and 11A exhibited poor (29%)tree and shrub survival for a variety of reasons, including shading by great ragweed, competition with other vegetation, and herbivore damage. Following discussions with the Trustees in summer 2010, and in an effort to improve the developing plant community, an adaptive management plan was developed to utilize replacement plantings to function to inhibit the spread of great ragweed from its current limits. This function will be accomplished by planting large (8-12 foot in height) trees with fast developing canopies around the ragweed to retard ragweed expansion by providing shade. The location of the general tree replanting area is shown on Figure 12. No shrubs are proposed for planting as they would have difficulty competing under current conditions and it is anticipated that once conditions improve, native shrubs will naturally colonize the restoration area. Tree species currently being considered to provide this function include red maple (*Acer rubrum*), silver maple (*Acer saccharinum*), sycamore (*Platanus occidentalis*), cottonwood (*Populus deltoides*), and American elm (*Ulmus americana*). The area proposed for tree replanting is shown on Figure 12. Specific locations for the individual tree species will be selected in the field at the time of planting based on hydrologic and topographic features.

At the original planting densities of 50 trees and 125 shrubs per acre in Zone 2 and 75 trees and 225 shrubs per acre in Zone 3, 871 trees and shrubs were planted in 2008/2009 in Removal Areas 11A, 12A, and 13A. Of these planted trees and shrubs, 253 were observed in 2010. Targeting an 85% survival, 740 of the originally planted trees and shrubs would have needed to survive to meet the performance standard. Subtracting 253 from 740 results in the need for 487 trees and shrubs. Because the trees proposed for replanting in 2011 are at least double the height of the originally planted trees, each tree to be planted in 2011 would equate to 2 trees or 4 shrubs. At an approximate planting ratio of 3 shrubs:1 tree, a total number of 152 trees should be planted to compensate for the trees and shrubs that did not survive.

The 152 trees that will be planted in spring 2011 will receive an increased level of protection and maintenance that could not feasibly be provided to the originally planted number of trees and shrubs. Each tree will be protected from deer and beaver by installing a protective wrap or cage around the trunk and the root ball will be fertilized upon installation. Maintenance will include watering, as needed; mowing of herbaceous vegetation that could compete with the tree or provide cover for herbivorous small mammal; and pruning, as required to adjust the crown to root development. If watering is required, water will be drawn from the Kalamazoo River. The larger size of the planted trees in relation to original plantings, and the increased level of maintenance provided to them will functionally compensate for the trees and shrubs

that did not survive in these restoration areas and provide a mechanism to control the spread of ragweed and other invasive weeds into these restored habitats. These plant community improvements will also provide conditions that will support colonization of the restoration area with native trees and shrubs and the establishment of the desired riparian habitat over time.

5.3 Bank Repairs

During bank monitoring activities, approximately 35 feet of bank in Removal Area 9B (the Repair Area) was observed to be showing signs of localized erosion. Figure 13 presents a photograph of the eroded area and Figure 14 shows the bank repair area limits. The Repair Area is a part of a larger area that showed signs of erosion and was subsequently repaired in 2009 (2009 Bank Repair). The 2009 Bank Repair consisted of placing river run rock from the observed top-of-bank shelf to the river bed at an approximate 2:1 (horizontal:vertical) slope. In addition to the rock toe protection, the remaining portions of the shelf behind (landward) the rock were provided with additional erosion protection by the installation of a coir log at the prism-out median water elevation. Seeding and erosion control fabric were installed landward of the coir log to promote vegetative growth to stabilize the bank. The design of that repair and details of erosive forces in that area is described in detail in the September 15, 2009 letter to the Trustees titled *Plainwell Bank Maintenance/Repair and Approach for Erosion in Removal Areas 8 and 9B* (ARCADIS 2009).

After the erosion was observed, survey data were collected to quantify the extent of erosion in the Repair Area and to assist in designing the repair for the area. Topographic data were collected from five survey transects (B1 to B5 on Figure 14) in August 2010 between the coir log and top-of-bank. Survey data from these transects were compared to survey data collected in June 2009 as a part of the 2009 Bank Repair. Approximately 435 square feet of bank area between transects B2 and B4 was targeted for repair. The average elevation difference between the 2009 bank surface and 2010 bank surface was approximately 1 foot.

The erosion observed in the Repair Area was generally focused near Transect B3. In order to repair the impacted area, the bank between Transects B2 and B4 was regraded to a smooth slope and protected with additional armor stone. The existing bank soil in the area was graded using an excavator to form a smooth slope throughout the Repair Area and river run rock was placed between the coir log and top-of-bank in the areas between Transect B2 and B4 (Figure 14). The river run rock consisted of six-inch mean diameter rounded stone with a maximum diameter of nine inches. A non-woven geotextile fabric was installed prior to rock placement to protect against erosion behind the rock. The geotextile fabric was anchored outside of the work areas using existing rock and soil. Approximately 15 cubic yards of river run rock were required to stabilize the 35 feet of bank in the Repair Area

No other bank areas were identified as requiring maintenance or repair activities.

5.4 Adaptive Management

In an adaptive management approach, observations of river tendencies are interpreted to evaluate their significance to the quality of the river and its riparian habitat. Adaptive management is being used in the evaluation of bank and floodplain conditions as the long-term water elevations become established. Specific attention is being paid to the final water/bank interface where the majority of observed erosion is occurring. Adaptive management remedies will be identified (as necessary) to address erosion and improve the overall habitat quality of the river shoreline. Adaptive management activities have included the installation of coir logs to protect the banks and increase the vegetative density of the shoreline. Other measures, such as reseeding or installing plant plugs where seeding was ineffective, or increasing the amount of armor protection will be evaluated on a case-by-case basis and discussed with the appropriate oversight agencies prior to installation.

Based on the results of the spring and summer 2010 monitoring events, tree replanting will be performed in portions of Removal Areas 11A, 12A, and 13A in response to observed mortalities and to restrict the expansion of a dense ragweed patch. In addition, an eroded portion of bank in Removal Area 9B was repaired to stabilize the bank. The performance of these response actions will be documented after a period of 1 year following implementation of the response action or during the next scheduled monitoring event, whichever occurs sooner.

6. Future Monitoring and Reporting Activities

Monitoring activities will continue in the project area next year. The 2011 bank monitoring activities will consist of the following tasks.

1. Visual inspections and evaluations of bank conditions in spring.
2. Instrument topographic survey of bank profiles at 11 permanently benchmarked locations in spring.
3. Quantitative assessment of bank stability using the BEHI developed by Rosgen (2006) in spring.
4. Woody plant stem density assessment in spring.
5. Conduct a collaborative inspection of the banks and restored habitats with USEPA and the Trustees in mid-summer (July/August) and identify any areas requiring corrective action.
6. Submit a design for any potential corrective action to USEPA and the Trustees for review and comment.
7. Implement the corrective action as appropriate.
8. Quantitative evaluation of herbaceous vegetative cover.
9. Quantitative evaluation of invasive weed presence during the peak growing season.
10. Submit the final monitoring report to USEPA and the Trustees.

This process allows USEPA and the Trustees to review information about the restored banks and habitats early enough in the year so that any issues identified during the collaborative project area inspection can be designed and implemented in the same year the monitoring is being performed. Future annual monitoring reports will include the results of the entire year's monitoring efforts as well as descriptions of the corrective actions that were implemented prior to finalization of the monitoring report for that year.

7. References

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Rosgen, D. 2006. Applied River Morphology. Pagosa Springs, Colorado. Wildland Hydrology Books.

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Tables

Georgia-Pacific LLC
Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site
Former Plainwell Impoundment TCRA
Former Plainwell Impoundment 2010 Bank Conditions Monitoring Report

Table 1 - Bank Erosion Hazard Index Parameter Summary

Category		Bank Height Ratio (ft/ft)	Root Depth Ratio (%)	Root Density (%)	Bank Angle (°)	Surface Protection (%)	Total Index
Very Low	Value	1.0-1.1	100-90	100-80	0-20	100-80	
	Index	1-1.9	1-1.9	1-1.9	1-1.9	1-1.9	5-9.5
Low	Value	1.11-1.19	89-50	79-55	21-60	79-55	
	Index	2-3.9	2-3.9	2-3.9	2-3.9	2-3.9	10-19.5
Moderate	Value	1.2-1.5	49-30	54-30	61-80	54-30	
	Index	4-5.9	4-5.9	4-5.9	4-5.9	4-5.9	20-29.5
High	Value	1.6-2	29-15	29-15	81-90	29-15	
	Index	6-7.9	6-7.9	6-7.9	6-7.9	6-7.9	30-39.5
Very High	Value	2.1-2.8	14-5	14-5	91-119	14-10	
	Index	8-9	8-9	8-9	8-9	8-9	40-45
Extreme	Value	>2.8	<5	<5	>119	<10	
	Index	10	10	10	10	10	46-50

Numerical Adjustments:

Bedrock:	BEHI Very Low
Boulders:	BEHI Low
Cobble:	Decrease by one category if gravel/sand less than 50%
Gravel:	Adjust Index up 5-10 points depending on sand %
Sand:	Adjust Index up 10 points
Silt/clay:	No adjustment
Stratification:	Adjust Index up 5-10 points depending on position of unstable layers in relation to bankfull stage

Source: Rosgen (2006)

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Former Plainwell Impoundment 2010 Bank Conditions Monitoring Report

Table 2 - Bank Erosion Hazard Index Results

Location	Bank Height (feet)[1]	Bankfull Height (feet)[1]	Bank Height/ Bankfull Height	Bank Height/ Bankfull Height Value	Root Depth (inches)	Root Depth/ Bank Height Value	Root Density (%)	Root Density Value	Bank Angle (degrees)	Bank Angle Value	Surface Protection (%)	Surface Protection Value	Numerical Adjustments	Total Score	Erosion Potential
Area A1	=	=	1.0	1	2	6	50	4	20	2	70	2	5	20	Moderate
Area A2	=	=	1.0	1	8	4	50	4	13	1	50	6	10	26	Moderate
Area B1	=	=	1.0	1	3	6	100	1	6	1	100	1	5	15	Low
Area C1	=	=	1.0	1	3	6	70	2	5	1	70	2	0	12	Low
Area D1	=	=	1.0	1	6	5	100	1	9	1	100	1	0	9	Very Low
Area E1	6.1	4.8	1.3	5	6	9	50	6	16	2	75	2	0	24	Moderate
Area F1	8.2	5.7	1.4	5	6	5	100	1	23	2	100	1	0	14	Low
Area G1	11.3	6.0	1.9	8	6	5	90	1	21	2	90	1	5	22	Moderate
Area H1	12.9	7.7	1.7	6	6	5	50	4	23	2	100	1	-10	8	Very Low
Area H2	=	=	1.0	1	6	5	50	4	9	1	100	1	-10	2	Very Low
Area I1	=	=	1.0	1	6	5	90	1	10	1	90	1	5	14	Low
Area I2 (West)	=	=	1.0	1	6	5	100	1	3	1	100	1	0	9	Very Low
Area I2 (East)	=	=	1.0	1	6	5	50	4	90	8	30	6	0	24	Moderate
Area J1	=	=	1.0	1	13	4	80	2	60	4	80	2	0	13	Low
Area J2	=	=	1.0	1	6	5	20	7	69	5	100	1	0	19	Low
Area K1	6.3	3.9	1.6	6	6	5	70	2	19	2	70	2	0	17	Low
Area L1	=	=	1.0	1	6	5	60	2	0	1	60	4	0	13	Low
Area M1	=	=	1.0	1	6	5	100	1	3	1	100	1	10	19	Low
Area N1	=	=	1.0	10	6	5	20	7	83	6	40	5	0	33	High
Area O1	8.3	2.3	3.6	10	6	5	90	1	19	2	100	1	0	19	Low
Area O2	5.5	1.2	4.6	10	6	5	70	2	3	1	100	1	0	19	Low
Area O3	15.5	6.9	2.3	8	6	5	60	2	19	2	100	1	0	18	Low
Area O4	10.9	5.2	2.1	8	6	5	20	7	15	2	100	1	-10	13	Low

Notes:
1- "=" indicates that the bank height and the bankfull height were equal.
Red highlighting indicates degraded conditions that increased the bank erosion hazard ranking.
Green highlighting indicates improved conditions that decreased the erosion hazard ranking.

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Table 3 - 2010 Woody Vegetation Stem Count Summary

Removal Area	Number of Plants Planted	Number of Plants Observed in 2010	Percent of Originally Planted Stem Density (%)
North Bank Upstream of US-131 Bridge			
1	244	100	41
2A	100	231	231
3A	190	92	48
4A	100	125	125
5	40	22	55
Site Totals	**674**	**570**	**85**
North Bank Between US-131 Bridge and Former Plainwell Dam			
6A	114	91	80
9A	85	40	47
10A	70	23	33
11A	146	101	69
12A	220	129	59
13A	505	23	5
Site Totals	**1140**	**407**	**36**
Island Zone 3	**78**	**14**	**18**
South Bank Upstream and Downstream of US-131 Bridge			
3B	90	88	98
4B	163	26	16
6B	150	507	338
6B1 (+ Area N)	200	404	202
Site Totals	**603**	**1025**	**170**
South Bank Upstream of Former Plainwell Dam			
7	50	126	252
8	30	607	2023
9B	50	51	102
10B	165	80	48
12B	420	185	44
13B	600	217	36
Site Totals	**1315**	**1266**	**96**
Project Totals	**3810**	**3282**	**0.86**

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Table 4 - Herbaceous Vegetation Monitoring Summary

Removal Area	Average Percent Ground Cover	Average Percent Weed Cover
1	100	0.0
2A	98	1.7
3A	100	1.0
3B	100	1.0
4A	100	0.0
4B	100	0.0
5	100	0.0
6B	100	27.1
7	100	3.3
8	100	2.5
9A	100	0.0
9B	100	36.7
10A	100	7.5
10B	100	1.5
11A	100	20.0
11B	100	1.3
12A	86	20.8
12B	100	2.0
13A	97	0.0
13B	99	1.0
Average	**99**	**6.4**

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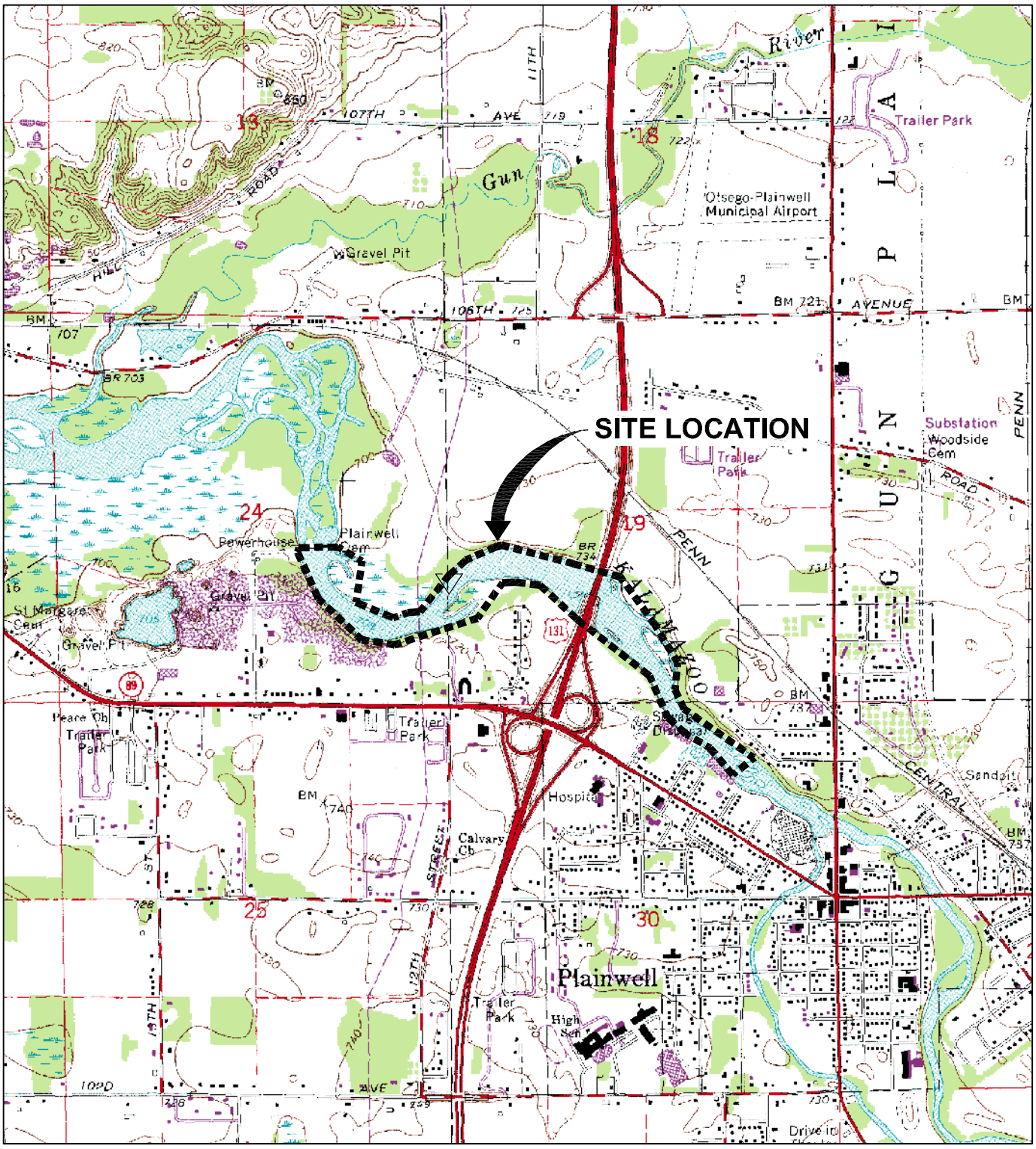
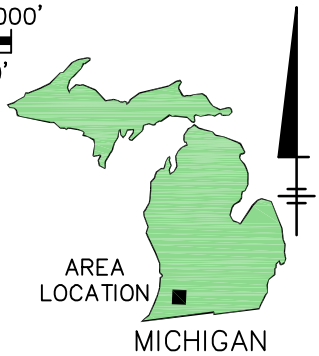
Figures



REFERENCE: USGS QUADS., 7.5 MIN. SERIES, DRG TOPOGRAPHIC MAP - ALLEGAN COUNTY, KALAMAZOO MICHIGAN.

0 2000' 4000'

Approximate Scale: 1" = 2000'



GEORGIA-PACIFIC LLC
ALLIED PAPER, INC./PORTAGE CREEK/
KALAMAZOO RIVER SUPERFUND SITE
FORMER PLAINWELL IMPOUNDMENT
2010 BANK CONDITIONS MONITORING REPORT

SITE LOCATION MAP

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FIGURE 1

CITY: SYRACUS DIVGROUP: 141/ENV DB: KLS PM: SDG LYR: ON=*;OFF=*REF*
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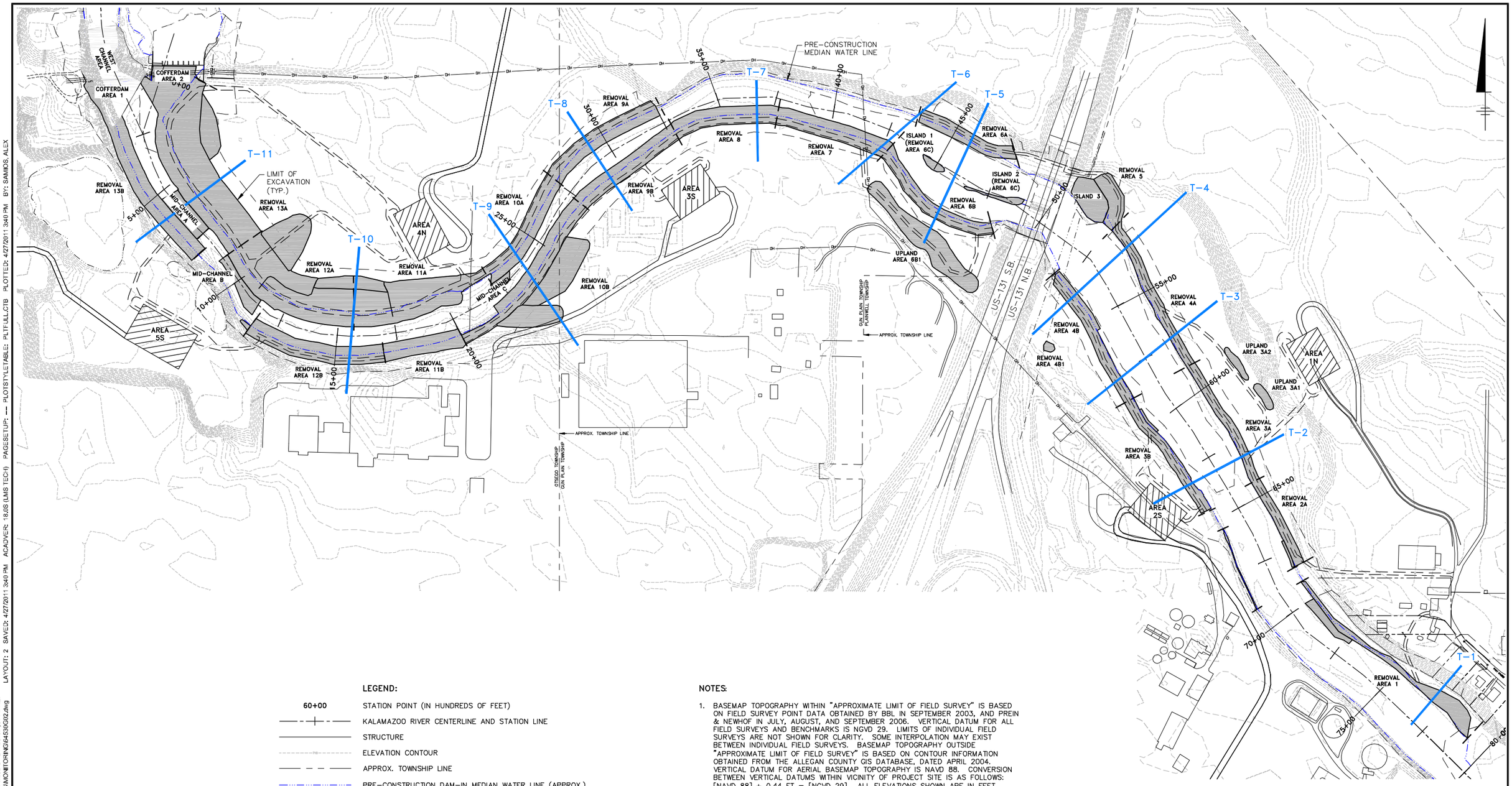

LEGEND:

60+00	STATION POINT (IN HUNDREDS OF FEET)
	KALAMAZOO RIVER CENTERLINE AND STATION LINE
	STRUCTURE
710	ELEVATION CONTOUR
	APPROX. TOWNSHIP LINE
	PRE-CONSTRUCTION DAM-IN MEDIAN WATER LINE (APPROX.)
	APPROX. LIMIT OF FIELD SURVEY
	OFF-ROAD ACCESS ROUTE
	GRAVEL ACCESS ROAD
	STAGING AREA
	EXCAVATION AREA
T-1	MONITORING TRANSECT LOCATION AND ID

NOTES:

1. BASEMAP TOPOGRAPHY WITHIN "APPROXIMATE LIMIT OF FIELD SURVEY" IS BASED ON FIELD SURVEY POINT DATA OBTAINED BY BBL IN SEPTEMBER 2003, AND PREIN & NEWHOF IN JULY, AUGUST, AND SEPTEMBER 2006. VERTICAL DATUM FOR ALL FIELD SURVEYS AND BENCHMARKS IS NGVD 29. LIMITS OF INDIVIDUAL FIELD SURVEYS ARE NOT SHOWN FOR CLARITY. SOME INTERPOLATION MAY EXIST BETWEEN INDIVIDUAL FIELD SURVEYS. BASEMAP TOPOGRAPHY OUTSIDE "APPROXIMATE LIMIT OF FIELD SURVEY" IS BASED ON CONTOUR INFORMATION OBTAINED FROM THE ALLEGAN COUNTY GIS DATABASE, DATED APRIL 2004. VERTICAL DATUM FOR AERIAL BASEMAP TOPOGRAPHY IS NAVD 88. CONVERSION BETWEEN VERTICAL DATUMS WITHIN VICINITY OF PROJECT SITE IS AS FOLLOWS: [NAVD 88] + 0.44 FT = [NGVD 29]. ALL ELEVATIONS SHOWN ARE IN FEET. HORIZONTAL DATUM FOR ALL SURVEY INFORMATION (I.E., FIELD AND AERIAL) IS STATE PLANE, NAD 83, MICHIGAN SOUTH ZONE (2113), INTERNATIONAL FEET.

2. EXISTING FACILITIES, STRUCTURES, AND UTILITIES HAVE BEEN PLOTTED FROM AVAILABLE PLANS, RECORDS AND SURVEYS, AND, THEREFORE, THEIR LOCATIONS, MATERIALS, AND TYPE OF USE MUST BE CONSIDERED APPROXIMATE ONLY.

0 200' 400'
GRAPHIC SCALE

GEORGIA-PACIFIC LLC
ALLIED PAPER INC./PORTAGE CREEK/
KALAMAZOO RIVER SUPERFUND SITE
FORMER PLAINWELL IMPOUNDMENT
2010 BANK CONDITIONS MONITORING REPORT

RIVER BANK MONITORING TRANSECT LOCATIONS

ARCADIS

FIGURE
2

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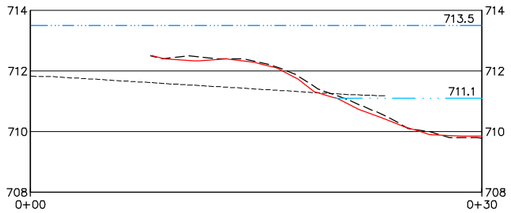
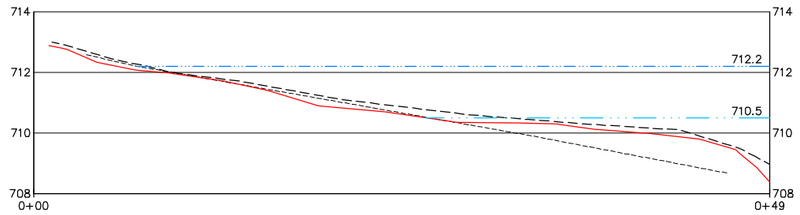


T-1N (NORTH BANK)

SCALE AS NOTED



T-2N (NORTH BANK)

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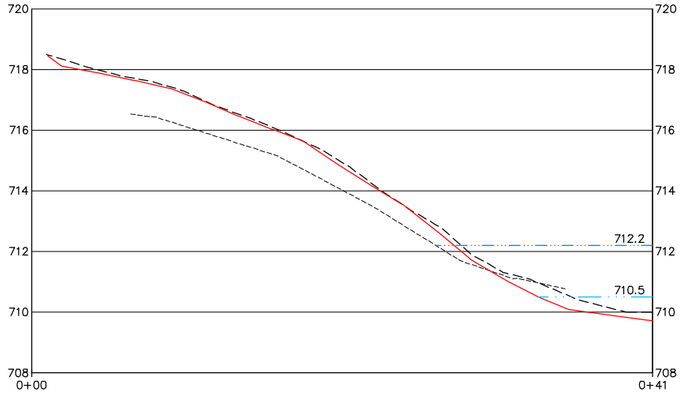


T-2S (SOUTH BANK)

SCALE AS NOTED

LEGEND:

- POST-CONSTRUCTION SURVEYED GRADE
- 2009 SURVEYED GRADE
- 2010 SURVEYED GRADE
- PRISM-OUT 2-YEAR WATER LINE
- PRISM-OUT MEDIAN WATER LINE

0 5' 10'

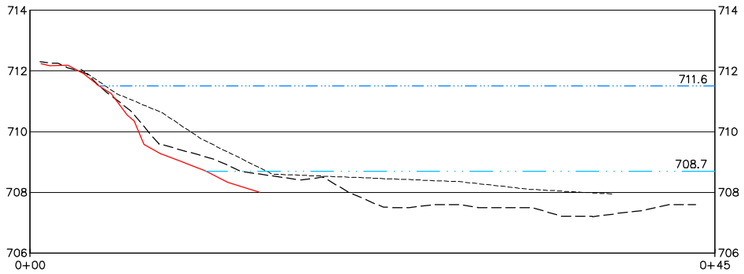
GRAPHIC SCALE
(2X VERTICAL EXAGGERATION)

GEORGIA-PACIFIC LLC
ALLIED PAPER INC./PORTAGE CREEK/
KALAMAZOO RIVER SUPERFUND SITE
FORMER PLAINWELL IMPOUNDMENT
2010 BANK CONDITIONS MONITORING REPORT

MONITORING TRANSECT CROSS SECTIONS - T-1 AND T-2

ARCADIS

FIGURE
3



T-3N (NORTH BANK)

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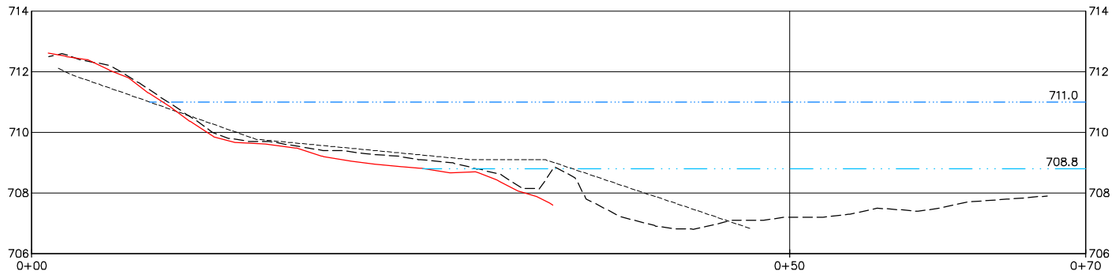

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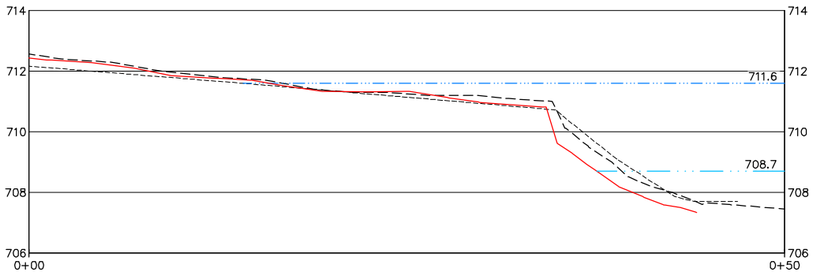
SCALE AS NOTED



T-3S (SOUTH BANK)

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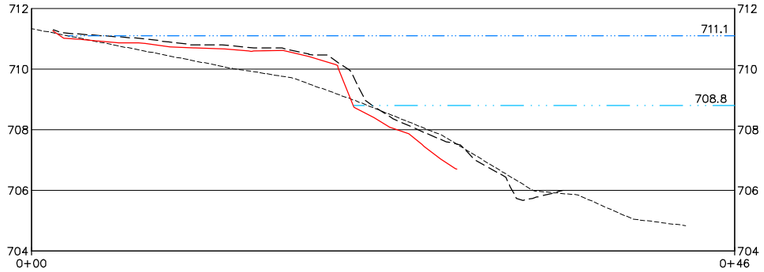


T-4S (SOUTH BANK)

SCALE AS NOTED

LEGEND:

- POST-CONSTRUCTION SURVEYED GRADE
- 2009 SURVEYED GRADE
- 2010 SURVEYED GRADE
- PRISM-OUT 2-YEAR WATER LINE
- PRISM-OUT MEDIAN WATER LINE

0 5' 10'

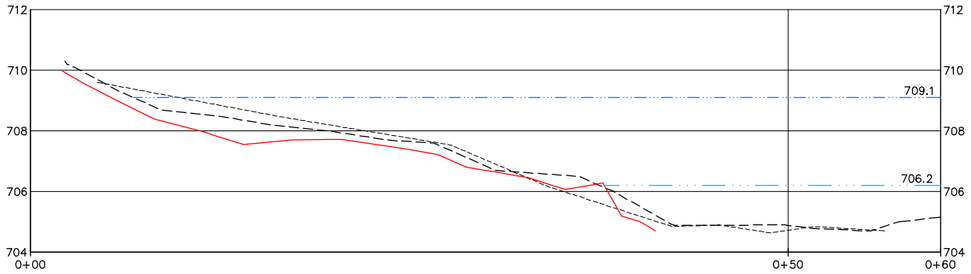
GRAPHIC SCALE
(2X VERTICAL EXAGGERATION)

GEORGIA-PACIFIC LLC
ALLIED PAPER INC./PORTAGE CREEK/
KALAMAZOO RIVER SUPERFUND SITE
FORMER PLAINWELL IMPOUNDMENT
2010 BANK CONDITIONS MONITORING REPORT

MONITORING TRANSECT CROSS SECTIONS - T-3 AND T-4

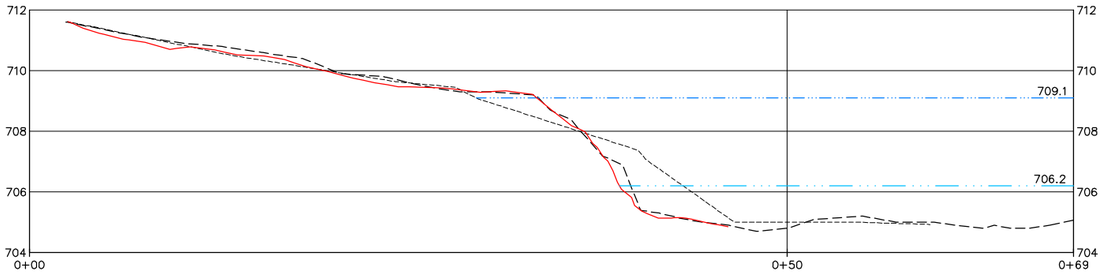
ARCADIS

FIGURE
4



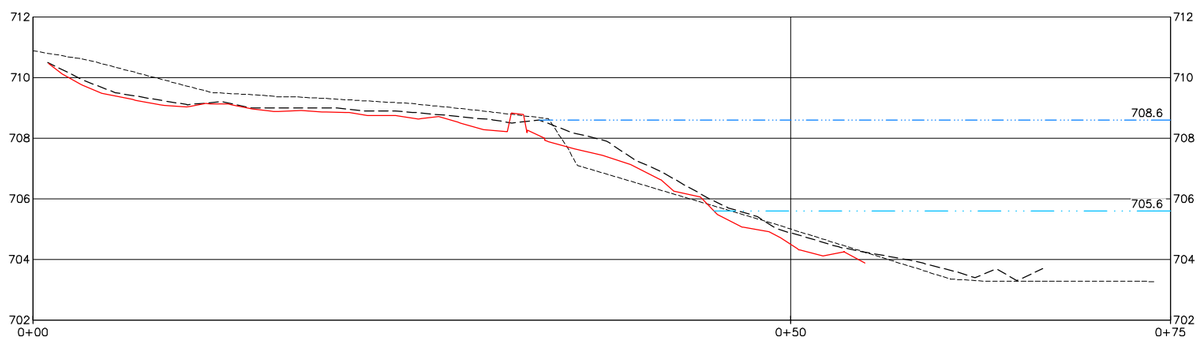
T-5N (NORTH BANK)

SCALE AS NOTED



T-5S (SOUTH BANK)

SCALE AS NOTED



T-6S (SOUTH BANK)

SCALE AS NOTED

LEGEND:

- POST-CONSTRUCTION SURVEYED GRADE
- 2009 SURVEYED GRADE
- 2010 SURVEYED GRADE
- PRISM-OUT 2-YEAR WATER LINE
- PRISM-OUT MEDIAN WATER LINE

0 5' 10'

GRAPHIC SCALE
(2X VERTICAL EXAGGERATION)

GEORGIA-PACIFIC LLC
ALLIED PAPER INC./PORTAGE CREEK/
KALAMAZOO RIVER SUPERFUND SITE
FORMER PLAINWELL IMPOUNDMENT
2010 BANK CONDITIONS MONITORING REPORT

MONITORING TRANSECT CROSS SECTIONS - T-5 AND T-6

ARCADIS

FIGURE
5

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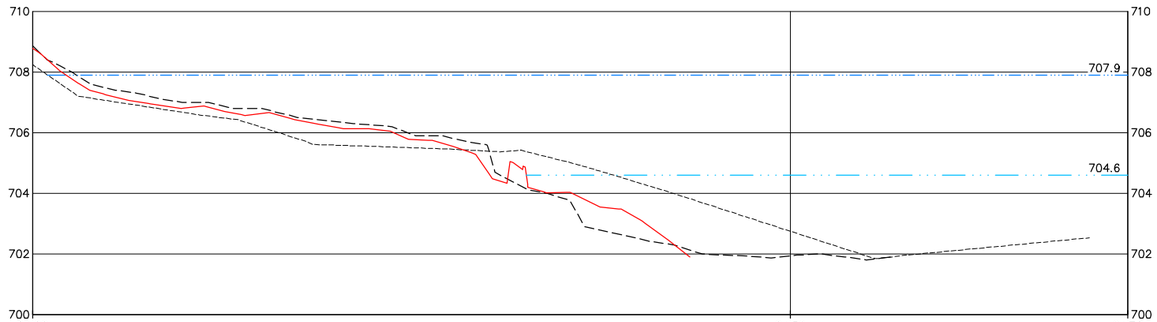

T-7S (SOUTH BANK)

SCALE AS NOTED

LEGEND:

- POST-CONSTRUCTION SURVEYED GRADE
- 2009 SURVEYED GRADE
- 2010 SURVEYED GRADE
- PRISM-OUT 2-YEAR WATER LINE
- PRISM-OUT MEDIAN WATER LINE

0 5' 10'

GRAPHIC SCALE
(2X VERTICAL EXAGGERATION)

GEORGIA-PACIFIC LLC
ALLIED PAPER INC./PORTAGE CREEK/
KALAMAZOO RIVER SUPERFUND SITE
FORMER PLAINWELL IMPOUNDMENT
2010 BANK CONDITIONS MONITORING REPORT

MONITORING TRANSECT CROSS SECTIONS - T-7

ARCADIS

FIGURE
6

CITY:SYRACUSE DIV/GROUP:ENV/CAD DB:AGS LD:AGS PM:SDG LYRON=*OFF=*REF*
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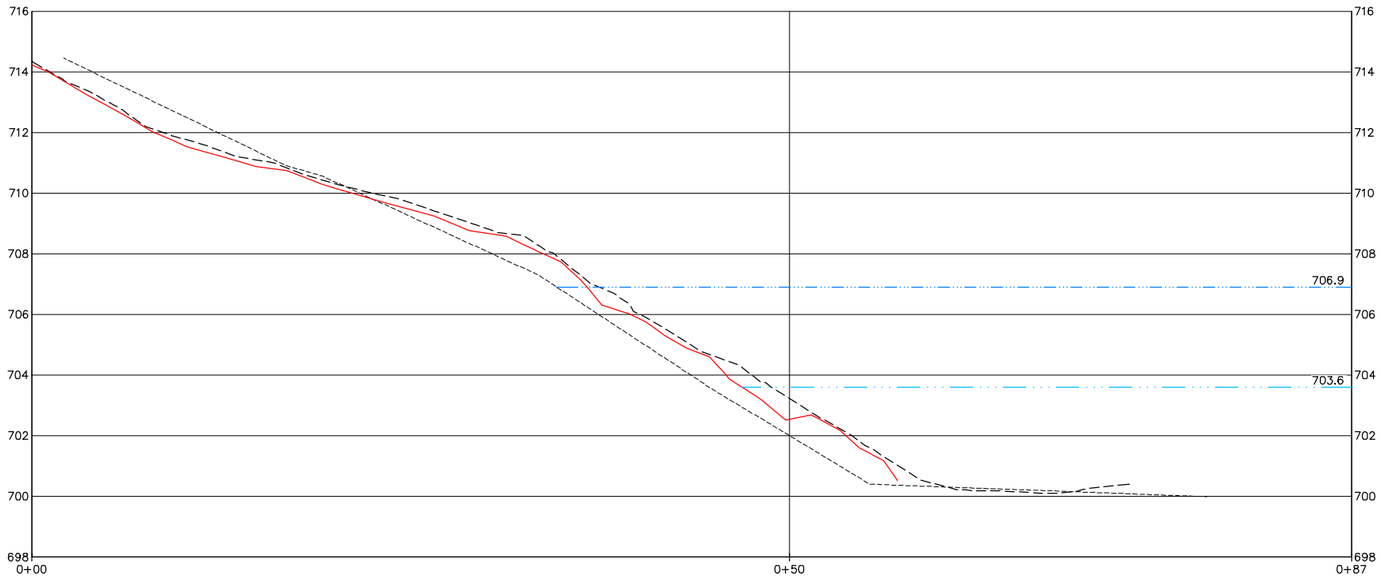
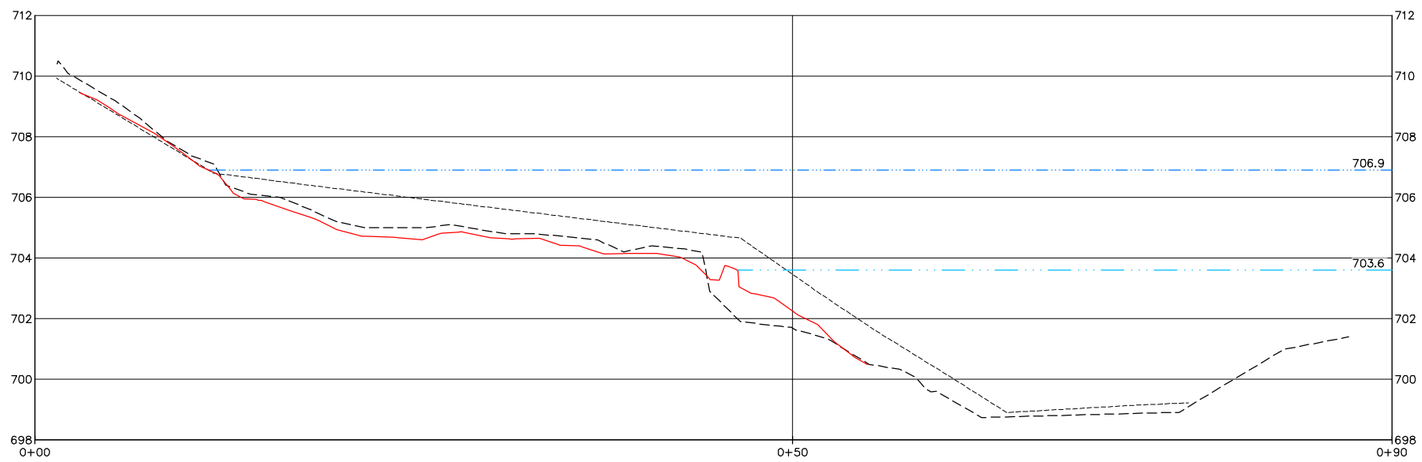


T-8N (NORTH BANK)

SCALE AS NOTED



T-8S (SOUTH BANK)

SCALE AS NOTED

LEGEND:

- POST-CONSTRUCTION SURVEYED GRADE
- 2009 SURVEYED GRADE
- 2010 SURVEYED GRADE
- PRISM-OUT 2-YEAR WATER LINE
- PRISM-OUT MEDIAN WATER LINE

0 5' 10'

GRAPHIC SCALE
(2X VERTICAL EXAGGERATION)

GEORGIA-PACIFIC LLC
ALLIED PAPER INC./PORTAGE CREEK/
KALAMAZOO RIVER SUPERFUND SITE
FORMER PLAINWELL IMPOUNDMENT
2010 BANK CONDITIONS MONITORING REPORT

MONITORING TRANSECT CROSS SECTIONS - T-8

ARCADIS

FIGURE
7

CITY:SYRACUSE DIV/GROUP: ENV/CAD DB:AGS LD:AGS PM:SDG LYR:ON=*;OFF=*REF* PAGESETUP: LD2B-PDF-AGS PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 4/27/2011 4:30 PM BY: SAMIOS, ALEX
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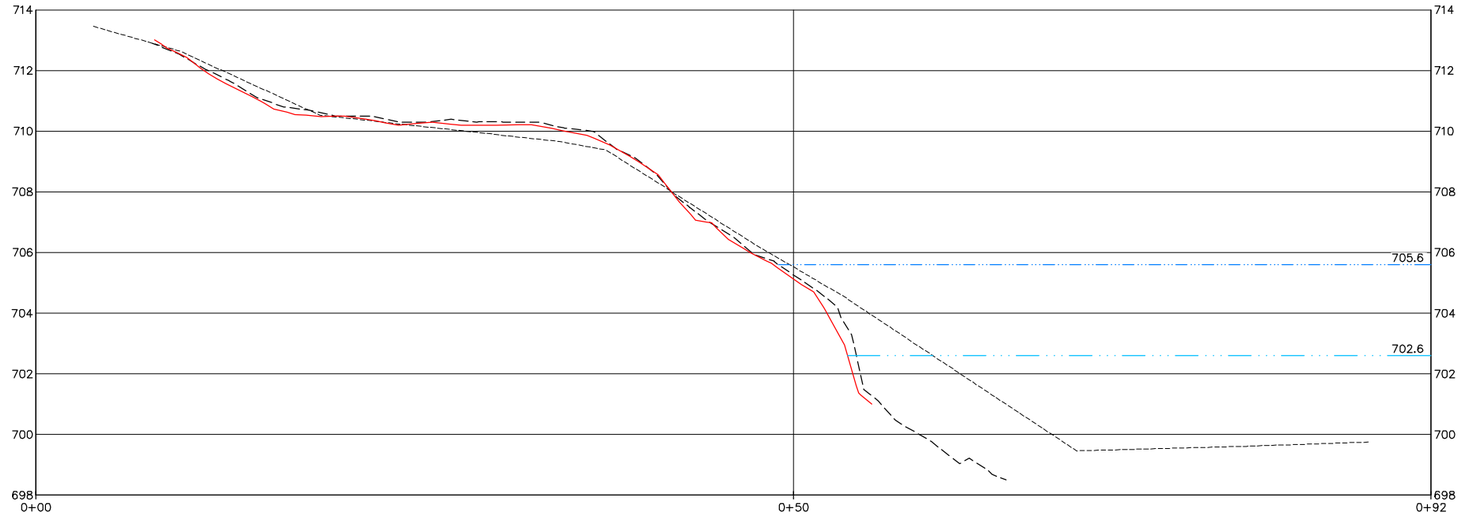

T-9N (NORTH BANK)

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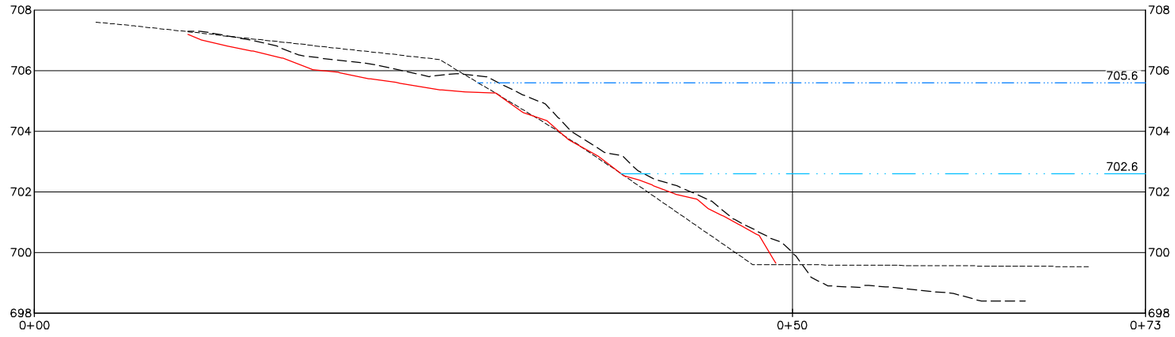


T-9S (SOUTH BANK)

SCALE AS NOTED

LEGEND:

- POST-CONSTRUCTION SURVEYED GRADE
- 2009 SURVEYED GRADE
- 2010 SURVEYED GRADE
- PRISM-OUT 2-YEAR WATER LINE
- PRISM-OUT MEDIAN WATER LINE

0 5' 10'

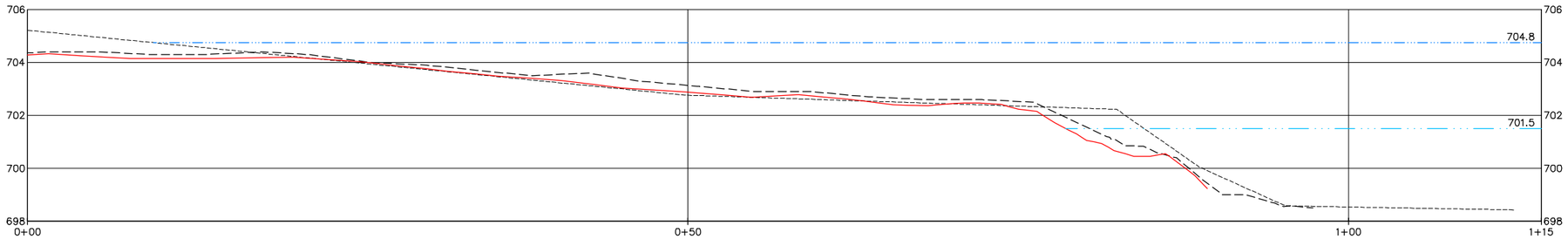
GRAPHIC SCALE
(2X VERTICAL EXAGGERATION)

GEORGIA-PACIFIC LLC
ALLIED PAPER INC./PORTAGE CREEK/
KALAMAZOO RIVER SUPERFUND SITE
FORMER PLAINWELL IMPOUNDMENT
2010 BANK CONDITIONS MONITORING REPORT

MONITORING TRANSECT CROSS SECTIONS - T-9

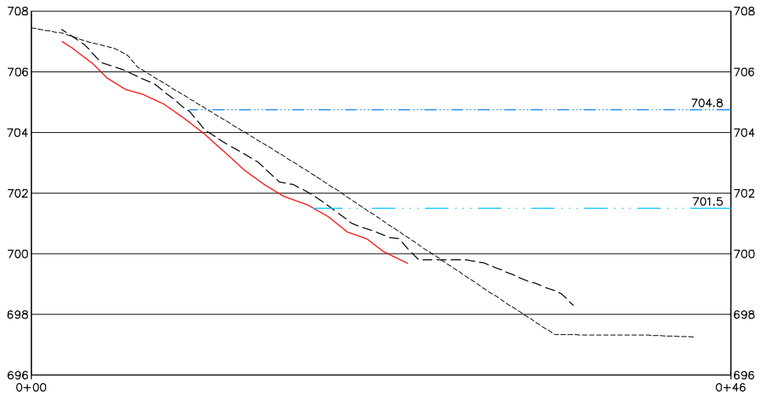
ARCADIS

FIGURE
8



T-10N (NORTH BANK)

SCALE AS NOTED



T-10S (SOUTH BANK)

SCALE AS NOTED

LEGEND:

- POST-CONSTRUCTION SURVEYED GRADE
- 2009 SURVEYED GRADE
- 2010 SURVEYED GRADE
- PRISM-OUT 2-YEAR WATER LINE
- PRISM-OUT MEDIAN WATER LINE

0 5' 10'

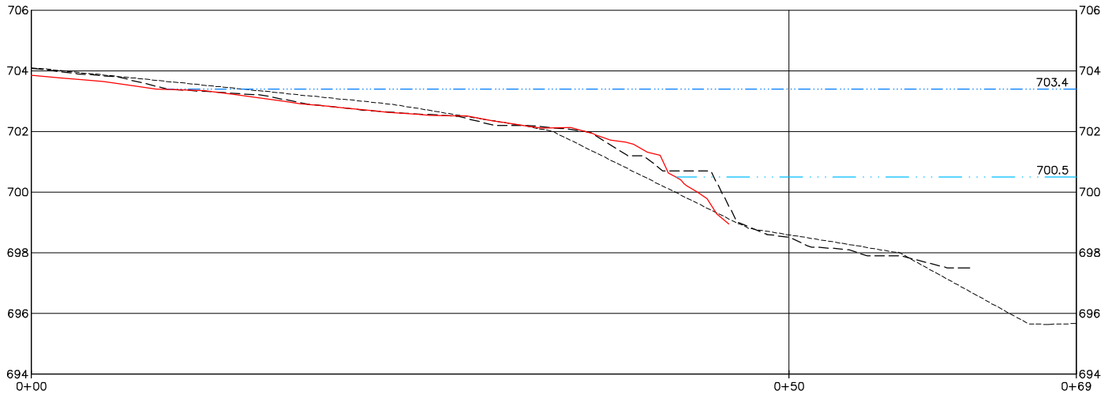
GRAPHIC SCALE
(2X VERTICAL EXAGGERATION)

GEORGIA-PACIFIC LLC
ALLIED PAPER INC./PORTAGE CREEK/
KALAMAZOO RIVER SUPERFUND SITE
FORMER PLAINWELL IMPOUNDMENT
2010 BANK CONDITIONS MONITORING REPORT

MONITORING TRANSECT CROSS SECTIONS - T-10

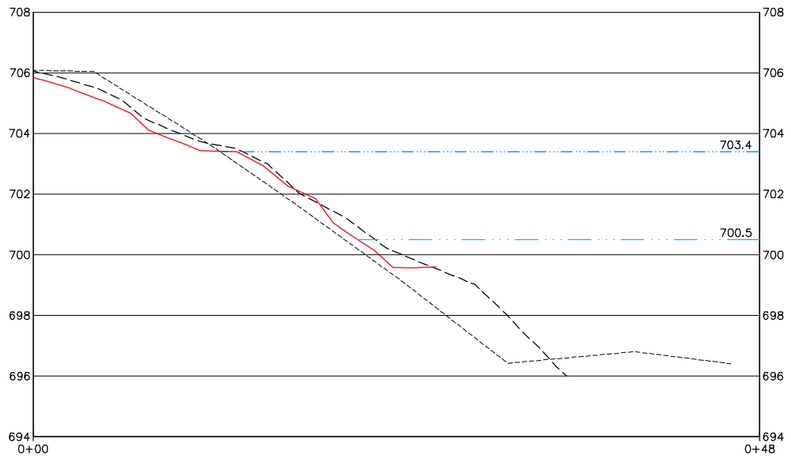
ARCADIS

FIGURE
9



T-11N (NORTH BANK)

SCALE AS NOTED



T-11S (SOUTH BANK)

SCALE AS NOTED

LEGEND:

- POST-CONSTRUCTION SURVEYED GRADE
- 2009 SURVEYED GRADE
- 2010 SURVEYED GRADE
- PRISM-OUT 2-YEAR WATER LINE
- PRISM-OUT MEDIAN WATER LINE

0 5' 10'

GRAPHIC SCALE
(2X VERTICAL EXAGGERATION)

GEORGIA-PACIFIC LLC
ALLIED PAPER INC./PORTAGE CREEK/
KALAMAZOO RIVER SUPERFUND SITE
FORMER PLAINWELL IMPOUNDMENT
2010 BANK CONDITIONS MONITORING REPORT

MONITORING TRANSECT CROSS SECTIONS - T-11

ARCADIS

FIGURE
10

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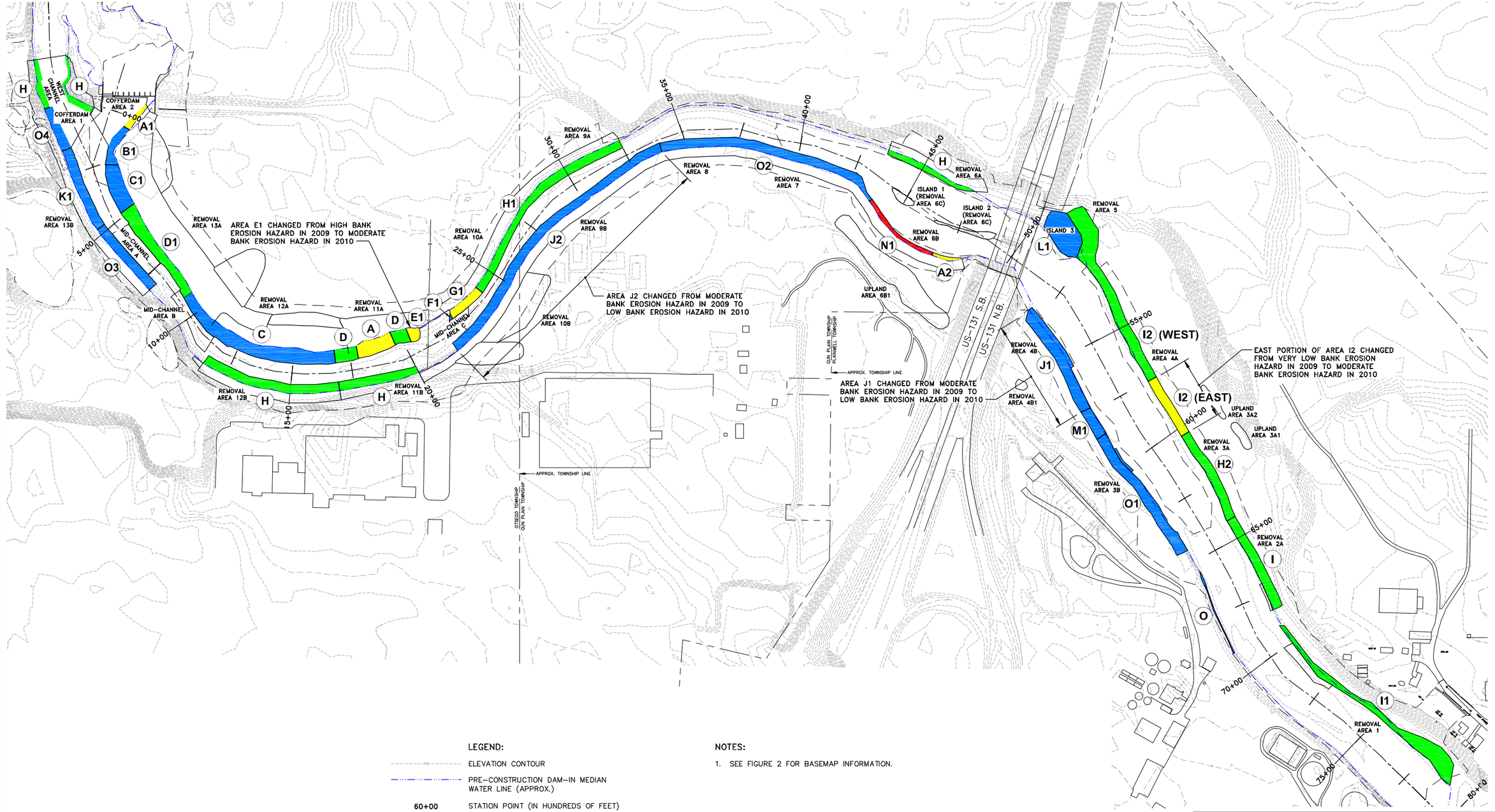


LEGEND:

- ELEVATION CONTOUR
- PRE-CONSTRUCTION DAM-IN MEDIAN WATER LINE (APPROX.)
- 60+00 STATION POINT (IN HUNDREDS OF FEET)
- KALAMAZOO RIVER CENTERLINE AND STATION LINE
- HIGH BANK EROSION HAZARD
- MODERATE BANK EROSION HAZARD
- LOW BANK EROSION HAZARD
- VERY LOW BANK EROSION HAZARD

NOTES:

1. SEE FIGURE 2 FOR BASEMAP INFORMATION.

0 200' 400'
GRAPHIC SCALE

GEORGIA-PACIFIC LLC
ALLIED PAPER INC./PORTAGE CREEK/
KALAMAZOO RIVER SUPERFUND SITE
FORMER PLAINWELL IMPOUNDMENT
2010 BANK CONDITIONS MONITORING REPORT

BANK EROSION HAZARD RANKING SUMMARY

ARCADIS

FIGURE 11

REMOVAL AREA 13A

PRISM–OUT 2–YEAR SPRING FLOW ELEVATION/ TOP OF BANK

PRISM–OUT 2–YEAR FLOW ELEVATION

PRISM–IN 2–YEAR FLOW ELEVATION

UPLAND AREA 12A1

6+00

MID–CHANNEL AREA A

7+00

8+00

9+00

MID–CHANNEL AREA B

10+00

11+00

12+00

13+00

14+00

15+00

16+00

17+00

18+00

19+00

20+00

21+00

REMOVAL AREA 12A

REMOVAL AREA 11A

FLOW

KALAMAZOO RIVER

REMOVAL AREA 12B

REMOVAL AREA 11B

LEGEND:

- APPROX. LIMIT OF REMOVAL AREA
- AS–BUILT PLANTING ZONE 1
- AS–BUILT PLANTING ZONE 2
- AS–BUILT PLANTING ZONE 3
- AS–BUILT RIVER RUN ROCK
- ACCESS ROAD – RESTORED
- ACCESS ROAD – NOT RESTORED
- TOPSOIL AND PLANTING ZONE 1 SPECIES
- PROPOSED AREA OF TREE REPLANTING
- APPROXIMATE LOCATION OF RAGWEED

NOTE:

1. FLOW LIMITS SHOWN ON THIS DRAWING ARE BASED ON MODELING AS DESCRIBED IN SECTION 2.7 OF THE DESIGN REPORT. ACTUAL FLOW LIMITS VARIED THROUGHOUT WORK ACTIVITIES. IF THE FLOW ELEVATION EXCEEDED MODELED PRISM–OUT 2–YEAR SPRING FLOW ELEVATION, PLANTING ZONE 1 WAS INSTALLED TO THE FLOW ELEVATION AT THE TIME OF INSTALLATION. EXTENT OF PLANTING ZONES AND RIVER RUN ROCK WERE SURVEYED AT THE TIME OF INSTALLATION.

0 50' 100'
GRAPHIC SCALE

GEORGIA-PACIFIC LLC
ALLIED PAPER INC./PORTAGE CREEK/
KALAMAZOO RIVER SUPERFUND SITE
FORMER PLAINWELL IMPOUNDMENT
2010 BANK CONDITIONS MONITORING REPORT

PROPOSED TREE REPLANTING AREA (REMOVAL AREA 11A, 12A, AND 13A)

ARCADIS

FIGURE
12

Area of south bank in Removal Area 9B requiring repair.

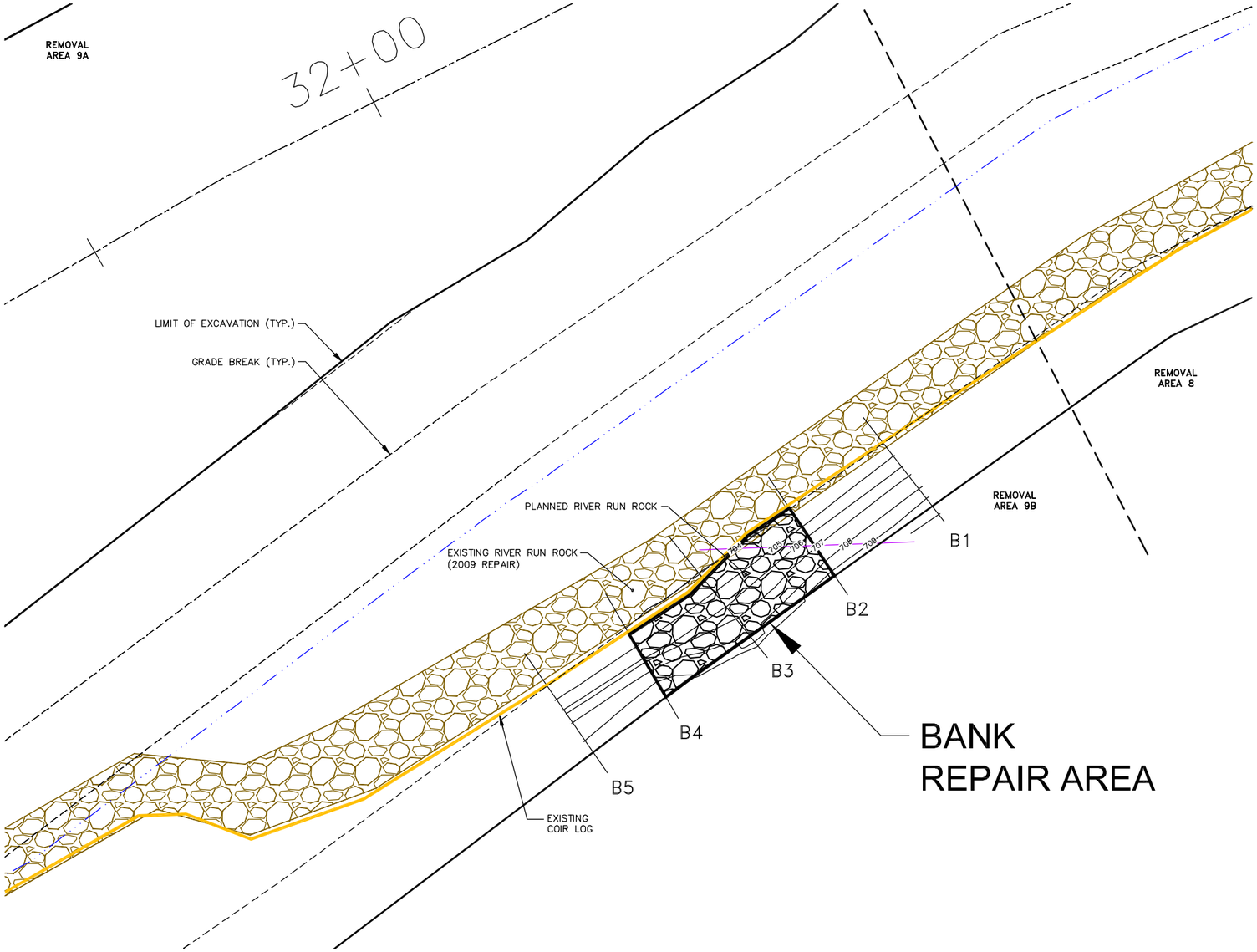
GEORGIA-PACIFIC LLC
ALLIED PAPER, INC./PORTAGE CREEK/
KALAMAZOO RIVER SUPERFUND SITE
FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

BANK AREA REQUIRING REPAIR

ARCADIS

FIGURE
13

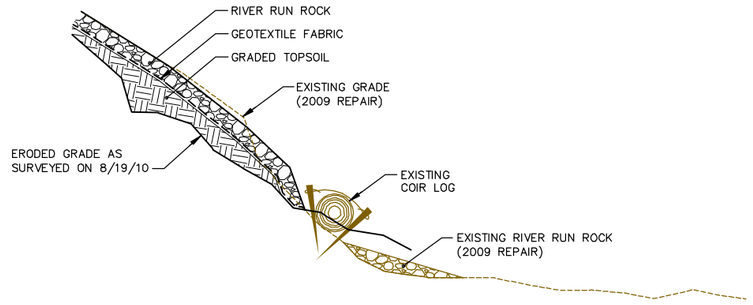
04/27/2011 SYRACUSE, NY-ENV/CAD DJHOWES
B0064530/0001/00907/CDR/TCRA/64530G19.CDR



PLAN

0 10' 20'

GRAPHIC SCALE



RESTORATION CROSS SECTION
SOUTH BANK

NOT TO SCALE
(2X VERTICAL EXAGGERATION)

GEORGIA-PACIFIC LLC
ALLIED PAPER INC./PORTAGE CREEK/
KALAMAZOO RIVER SUPERFUND SITE
FORMER PLAINWELL IMPOUNDMENT
2010 BANK CONDITIONS MONITORING REPORT

BANK EROSION REPAIR PLAN AND CROSS SECTION

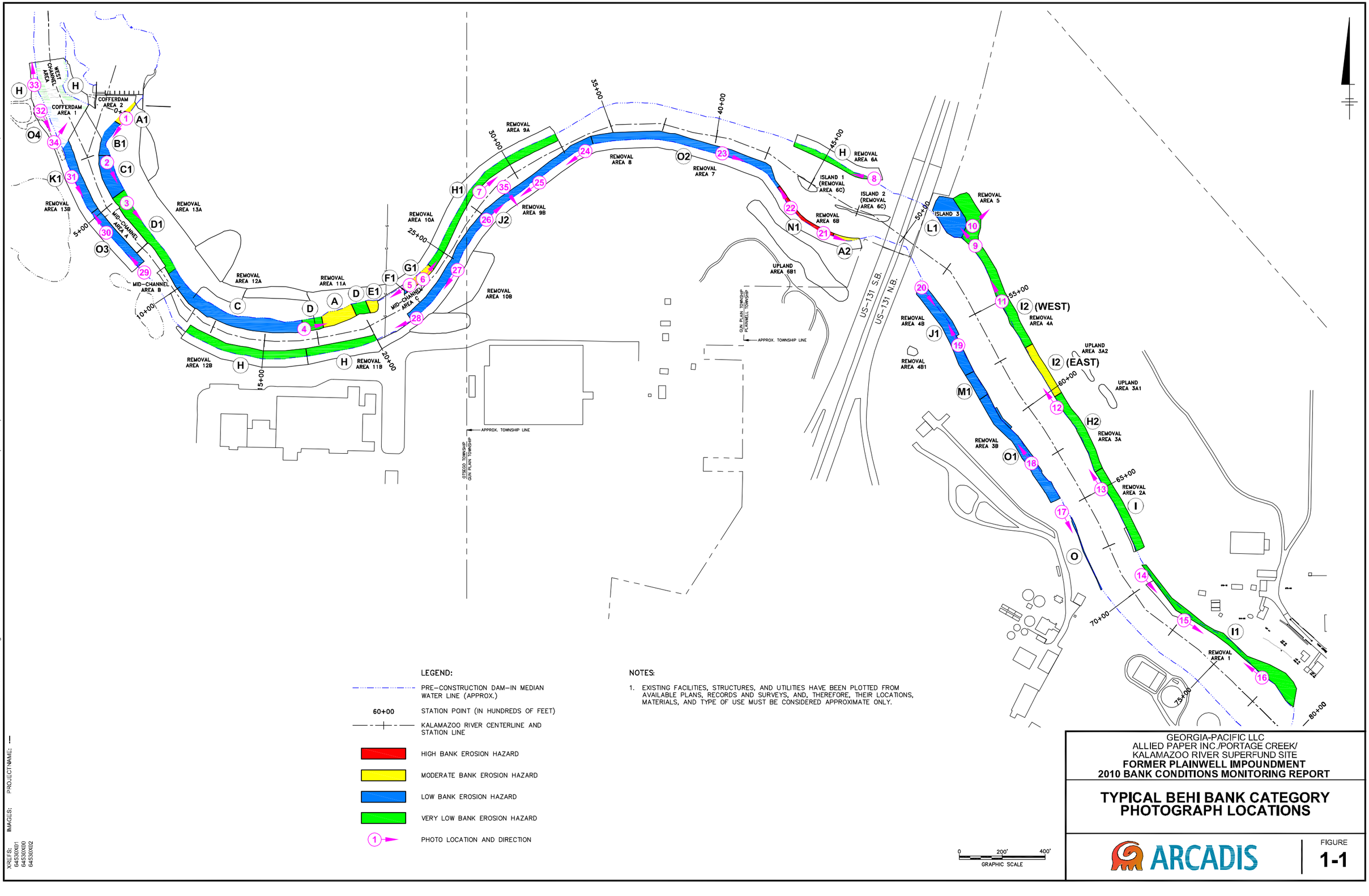
ARCADIS

FIGURE
14

ARCADIS

Attachment 1

Photographs of Typical BEHI Bank Categories



LEGEND:

- PRE-CONSTRUCTION DAM-IN MEDIAN WATER LINE (APPROX.)
- 60+00 — STATION POINT (IN HUNDREDS OF FEET)
- KALAMAZOO RIVER CENTERLINE AND STATION LINE
- HIGH BANK EROSION HAZARD
- MODERATE BANK EROSION HAZARD
- LOW BANK EROSION HAZARD
- VERY LOW BANK EROSION HAZARD
- 1 — PHOTO LOCATION AND DIRECTION

NOTES:

1. EXISTING FACILITIES, STRUCTURES, AND UTILITIES HAVE BEEN PLOTTED FROM AVAILABLE PLANS, RECORDS AND SURVEYS, AND, THEREFORE, THEIR LOCATIONS, MATERIALS, AND TYPE OF USE MUST BE CONSIDERED APPROXIMATE ONLY.

0 200' 400'
GRAPHIC SCALE

GEORGIA-PACIFIC LLC
ALLIED PAPER INC./PORTAGE CREEK/
KALAMAZOO RIVER SUPERFUND SITE
FORMER PLAINWELL IMPOUNDMENT
2010 BANK CONDITIONS MONITORING REPORT

TYPICAL BEHI BANK CATEGORY PHOTOGRAPH LOCATIONS

ARCADIS

FIGURE
1-1

CITY:SYRACUSE DIV/GROUP: ENV/CAD DB:AGS LD:AGS PM:SDG LYR:ON=*;OFF=*REF* G:\ENV\CAD\SYRACUSE\ACT\B0064530\00200907\DWG\MONITORING\64530G06.dwg LAYOUT: 1-1 SAVED: 4/27/2011 3:42 PM ACADVER: 18.0S (LMS TECH) *PAGESETUP*: --- PLOTSTYLETABLE: PLTFULL.CTB PLOTTED: 4/27/2011 3:42 PM BY: SAMOS, ALEX
XREFS:
64530X01
64530X00
64530X02
IMAGES:
PROJECTNAME: --

1

Photo #1: BEHI Area B1 (Low Erosion Potential) on north bank upstream of the former Plainwell Dam, looking southwest.

2

Photo #2: BEHI Area C1 (Low Erosion Potential) on north bank upstream of the former Plainwell Dam, looking southeast.

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FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

PHOTOGRAPHS OF TYPICAL BEHI BANK CATEGORIES

ARCADIS

FIGURE
1-2

3

Photo #3: BEHI Area D1 (Very Low Erosion Potential) on north bank upstream of the former Plainwell Dam, looking southeast.

4

Photo #4: BEHI Area D (Very Low Erosion Potential) on north bank upstream of the former Plainwell Dam, looking east.

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BANK CONDITIONS MONITORING REPORT

PHOTOGRAPHS OF TYPICAL BEHI BANK CATEGORIES

ARCADIS

FIGURE
1-3

5

Photo #5: BEHI Area E1 (Moderate Erosion Potential) on north bank at the regraded gas pipeline, looking southwest.

6

Photo #6: BEHI Area G1 (Moderate Erosion Potential) on north bank upstream of the gas pipeline, looking northeast.

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BANK CONDITIONS MONITORING REPORT

PHOTOGRAPHS OF TYPICAL BEHI BANK CATEGORIES

ARCADIS

FIGURE
1-4

7

Photo #7: BEHI Area H1 (Very Low Erosion Potential) on north bank, looking east.

8

Photo #8: BEHI Area H on north bank immediately downstream of the US-131 bridge, looking northwest.

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BANK CONDITIONS MONITORING REPORT

PHOTOGRAPHS OF TYPICAL BEHI BANK CATEGORIES

ARCADIS

FIGURE
1-5

04/27/2011 SYRACUSE, NY-ENV/CAD DJHOWES
B0064530/0001/00907/CDR/TCRA/64530G04.CDR

9

Photo #9: Island 3 on north bank, looking northwest from upstream.

10

Photo #10: BEHI Area I2 (Very Low Erosion Potential) on north bank immediately upstream of the US-131 bridge, looking north.

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FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

PHOTOGRAPHS OF TYPICAL BEHI BANK CATEGORIES

ARCADIS

FIGURE
1-6

11

Photo #11: BEHI Area I2 (Very Low Erosion Potential) on north bank upstream of the US-131 bridge, looking northwest.

12

Photo #12: BEHI Area I2 (East) (Moderate Erosion Potential) on north bank immediately upstream of the US-131 bridge, looking northwest.

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FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

PHOTOGRAPHS OF TYPICAL BEHI BANK CATEGORIES

ARCADIS

FIGURE
1-7

04/27/2011 SYRACUSE, NY-ENV/CAD DJHOWES
B0064530/0001/00907/CDR/TCRA/64530G06.CDR

13

Photo #13: BEHI Area H2 (Very Low Erosion Potential) on north bank upstream of the US-131 bridge, looking northwest.

14

Photo #14: BEHI Area I1 (Very Low Erosion Potential) on north bank upstream of the US-131 bridge, looking southeast.

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FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

PHOTOGRAPHS OF TYPICAL BEHI BANK CATEGORIES

ARCADIS

FIGURE
1-8

15

Photo #15: BEHI Area I1 (Very Low Erosion Potential) on north bank upstream of the US-131 bridge, looking southeast.

16

Photo #16: BEHI Area I1 (Very Low Erosion Potential) on north bank, looking northwest from upstream end.

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FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

PHOTOGRAPHS OF TYPICAL BEHI BANK CATEGORIES

ARCADIS

FIGURE
1-9

17

Photo #17: BEHI Area O (Low Erosion Potential) on south bank upstream of the US-131 bridge, looking southeast.

18

Photo #18: BEHI Area O1 (Low Erosion Potential) on south bank upstream of the US-131 bridge, looking west.

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FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

PHOTOGRAPHS OF TYPICAL BEHI BANK CATEGORIES

ARCADIS

FIGURE
1-10

19

Photo #19: BEHI Area J1 (Low Erosion Potential) on south bank immediately upstream of the US-131 bridge, looking northwest.

20

Photo #20: BEHI Area J1 (Low Erosion Potential) on south bank upstream of the US-131 bridge, looking southeast.

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FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

PHOTOGRAPHS OF TYPICAL BEHI BANK CATEGORIES

ARCADIS

FIGURE
1-11

21

Photo #21: BEHI Area A2 (Moderate Erosion Potential) on south bank downstream of the US-131 bridge, looking southeast.

22

Photo #22: BEHI Area N1 (High Erosion Potential) on south bank downstream of the US-131 bridge, looking northwest.

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FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

PHOTOGRAPHS OF TYPICAL BEHI BANK CATEGORIES

ARCADIS

FIGURE
1-12

23

Photo #23: BEHI Area O2 (Low Erosion Potential) on south bank downstream of the US-131 bridge, looking east.

24

Photo #24: BEHI Area J2 (Low Erosion Potential) on south bank downstream of the US-131 bridge, looking southwest.

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FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

PHOTOGRAPHS OF TYPICAL BEHI BANK CATEGORIES

ARCADIS

FIGURE
1-13

25

Photo #25: BEHI Area J2 (Low Erosion Potential) on south bank repaired in 2009 with rock and coir log.

26

Photo #26: BEHI Area J2 (Low Erosion Potential) on south bank, looking northeast.

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FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

PHOTOGRAPHS OF TYPICAL BEHI BANK CATEGORIES

ARCADIS

FIGURE
1-14

27

Photo #27: Downstream end of BEHI Area J2 (Low Erosion Potential) on south bank, looking southwest.

28

Photo #28: BEHI Area H on south bank, looking west.

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FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

PHOTOGRAPHS OF TYPICAL BEHI BANK CATEGORIES

ARCADIS

FIGURE
1-15

29

Photo #29: BEHI Area O3 (Low Erosion Potential) on south bank upstream of the former Plainwell Dam, looking northwest.

30

Photo #30: BEHI Area K1 (Low Erosion Potential) on south bank upstream of the former Plainwell Dam, looking northwest.

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FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

PHOTOGRAPHS OF TYPICAL BEHI BANK CATEGORIES

ARCADIS

FIGURE
1-16

31

Photo #31: BEHI Area K1 (Low Erosion Potential) on south bank upstream of the former Plainwell Dam, looking southeast.

32

Photo #32: BEHI Area K1 (Low Erosion Potential) on south bank upstream of the former Plainwell Dam, looking southeast.

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FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

PHOTOGRAPHS OF TYPICAL BEHI BANK CATEGORIES

ARCADIS

FIGURE
1-17

33

Photo #33: BEHI Area H (Very Low Erosion Potential) on south bank downstream of the former Plainwell Dam, looking northwest.

34

Photo #34: BEHI Area H on north bank at the former Plainwell Dam, looking northeast

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FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

PHOTOGRAPHS OF TYPICAL BEHI BANK CATEGORIES

ARCADIS

FIGURE
1-18

35

Photo #35: Collapsed top of south bank opposite former southern staging area.

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FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

PHOTOGRAPHS OF TYPICAL BEHI BANK CATEGORIES

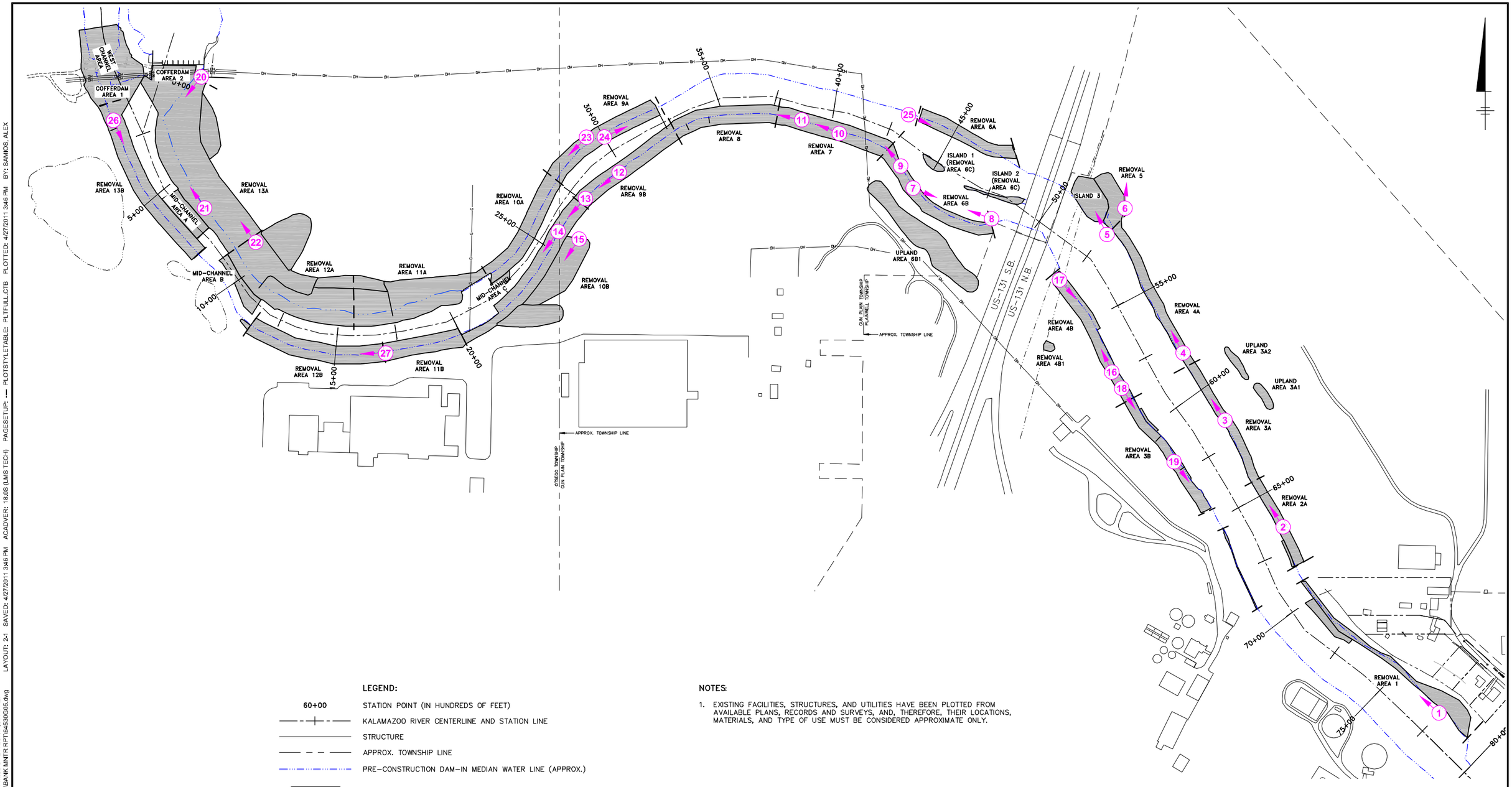
ARCADIS

FIGURE
1-19

04/27/2011 SYRACUSE, NY-ENV/CAD DJHOWES
B0064530/0001/00907/CDR/TCRA/64530G18.CDR

Attachment 2

Vegetation Documentation
Photographs



LEGEND:

- 60+00 — STATION POINT (IN HUNDREDS OF FEET)
- KALAMAZOO RIVER CENTERLINE AND STATION LINE
- STRUCTURE
- APPROX. TOWNSHIP LINE
- PRE-CONSTRUCTION DAM-IN MEDIAN WATER LINE (APPROX.)
- EXCAVATION AREA
- 1 — PHOTO LOCATION AND ID

NOTES:

1. EXISTING FACILITIES, STRUCTURES, AND UTILITIES HAVE BEEN PLOTTED FROM AVAILABLE PLANS, RECORDS AND SURVEYS, AND, THEREFORE, THEIR LOCATIONS, MATERIALS, AND TYPE OF USE MUST BE CONSIDERED APPROXIMATE ONLY.

0 200' 400'
GRAPHIC SCALE

GEORGIA-PACIFIC LLC
ALLIED PAPER INC./PORTAGE CREEK/
KALAMAZOO RIVER SUPERFUND SITE
FORMER PLAINWELL IMPOUNDMENT
2010 BANK CONDITIONS MONITORING REPORT

VEGETATION DOCUMENTATION PHOTOGRAPH LOCATIONS

ARCADIS

FIGURE
2-1

Photo #1: Vegetation of Removal Area 1, looking west from the east end.

1

Photo #2: Vegetation of western portion of Removal Area 2A, looking west from the east end.

2

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FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

Vegetation Documentation Photographs

ARCADIS

Figure 2-2

3

Photo #3: Vegetation of Removal Area 3A, looking west from the east end.

4

Photo #4: Vegetation of Removal Area 4A, looking west from the east end.

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BANK CONDITIONS MONITORING REPORT

Vegetation Documentation Photographs

ARCADIS

Figure 2-3

5

Photo #5: Vegetation of Island 3, looking west from east end.

6

Photo #6: Vegetation of Removal Area 5, looking north.

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FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

Vegetation Documentation Photographs

ARCADIS

Figure 2-4

7

Photo #7: Vegetation of eastern portion of Removal Area 6B, looking east.

8

Photo #8: Vegetation of eastern portion of Removal Area 6B, looking west.

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FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

Vegetation Documentation Photographs

ARCADIS

Figure 2-5

9

Photo #9: Vegetation of western portion of Removal Area 6B, looking west.

10

Photo #10: Vegetation of Removal Area 7, looking west from east end.

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FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

Vegetation Documentation Photographs

ARCADIS

Figure 2-6

11

Photo #11: Vegetation of Removal Area 8, looking west from east end.

12

Photo #12: Vegetation of central portion of Removal Area 9B, looking west.

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FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

Vegetation Documentation Photographs

ARCADIS

Figure 2-7

13

Photo #13: Vegetation of western portion of Removal Area 10B, looking west.

14

Photo #14: Vegetation of eastern portion of Removal Area 10B, looking west from east end.

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FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

Vegetation Documentation Photographs

ARCADIS

Figure 2-8

15

Photo #15: Vegetation of the upland portion of Removal Area 10B, looking southwest from the northeast corner.

16

Photo #16: Vegetation of western portion of Removal Area 4B, looking west.

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KALAMAZOO RIVER SUPERFUND SITE
FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

Vegetation Documentation Photographs

ARCADIS

Figure 2-9

17

Photo #17: Vegetation of western portion of Removal Area 4B, looking east from west end.

18

Photo #18: Vegetation of Removal Area 3B, looking east from west end.

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KALAMAZOO RIVER SUPERFUND SITE
FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

Vegetation Documentation Photographs

ARCADIS

Figure 2-10

19

Photo #19: Vegetation of Removal Area 3B, looking east from center.

20

Photo #20: Vegetation of Removal Area 13A, looking southeast from former dam location

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FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

Vegetation Documentation Photographs

ARCADIS

Figure 2-11

21

Photo #21: Vegetation of Removal Area 13A, looking west.

22

Photo #22: Vegetation of Removal Area 12A-1, looking west.

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FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

Vegetation Documentation Photographs

ARCADIS

Figure 2-12

23

Photo #23: Vegetation of Removal Area 9A, looking west.

24

Photo #24: Vegetation of Removal Area 9A, looking east from west end.

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KALAMAZOO RIVER SUPERFUND SITE
FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

Vegetation Documentation Photographs

ARCADIS

Figure 2-13

25

Photo #25: Vegetation of Removal Area 8A, looking east from west end.

26

Photo #26: Vegetation of Removal Area 13B, looking east from west end.

GEORGIA-PACIFIC LLC
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KALAMAZOO RIVER SUPERFUND SITE
FORMER PLAINWELL IMPOUNDMENT 2010
BANK CONDITIONS MONITORING REPORT

Vegetation Documentation Photographs

ARCADIS

Figure 2-14

Photo #27: Vegetation of Removal Area 12B, looking west from east end.

27

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BANK CONDITIONS MONITORING REPORT

Vegetation Documentation Photographs

ARCADIS

Figure 2-15

ARCADIS

Attachment 3

Herbaceous Vegetation
Monitoring Data

Georgia-Pacific LLC
Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site
Former Plainwell Impoundment TCRA
Former Plainwell Impoundment 2010 Bank Conditions Monitoring Report

Table 3-1 - Herbaceous Ground Cover in Sample Plots of Removal Area 12B

Observed Vegetation		% Cover				
Common Name	**Scientific Name**	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Beggar Ticks	*Bidens frondosa*		10%			
Black Eyed Susan	*Rudbeckia hirta*				30%	10%
Blue Vervain	*Verbena hastata*				10%	
Box Elder	*Acer negundo*	5%				
Bushy Aster	*Aster dumosus*	15%	10%			15%
Canada Thistle	*Cirsium arvense*			10%	5%	5%
Canada Wild Rye	*Elymus canadensis*		<5%	20%	5%	5%
Catnip	*Nepeta cataria*					15%
Clearweed	*Pilea pumila*	<5%				<5%
Cocklebur	*Xanthium strumarium*		<5%			
Common Ragweed	*Ambrosia artemisiifolia*		5%	20%		
Creeping Charlie	*Glechoma hederacea*					<5%
Curled dock	*Rumex crispus*		25%	5%	10%	10%
Daisy Fleabane	*Erigeron annuus*		25%		15%	
Dandelion	*Taraxicum officinale*					<5%
Gray Coneflower	*Ratibida pinnata*				10%	10%
Jewelweed	*Impatiens capensis*	75%		5%		20%
Pennsylvania Smartweed	*Polygonum pensylvanicum*		20%	5%		
Perennial Rye	*Lolium perenne*				5%	
Reed Canary Grass*	*Phalaris arundinacea*			5%		5%
Rough Stem Cinquefoil	*Potentilla norvegica*				5%	
Tall Goldenrod	*Solidago altissima*	5%	5%	10%	5%	
White Aster	*Aster vimineus*			20%		5%
Total % Ground Cover		100%	100%	100%	100%	100%
Average % Ground Cover		100%				

* Denotes invasive species.

Georgia-Pacific LLC
Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site
Former Plainwell Impoundment TCRA
Former Plainwell Impoundment 2010 Bank Conditions Monitoring Report

Table 3-2 - Herbaceous Ground Cover in Sample Plots of Removal Area 13A

Observed Vegetation		% Cover							
Common Name	**Scientific Name**	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**	**Plot 6**	**Plot 7**	**Plot 8**
Barnyard Grass	*Echinochloa crusgalli*	5%				5%	<5%	10%	
Black Willow	*Salix nigra*		30%						
Boxelder	*Acer negundo*							<5%	
Bushy Aster	*Aster dumosus*					45%		5%	
Canada Thistle	*Cirsium arvense*	35%							
Clearweed	*Pilea pumila*							10%	
Common Ragweed	*Ambrosia artemisiifolia*					20%			
Cottonwood	*Populus deltoides*		<5%						
Great Ragweed	*Ambrosia trifida*			100%	100%		20%		100%
Lady's Thumb	*Polygonum persicaria*	5%					45%	10%	
Nodding Smartweed	*Polygonum lapathifolium*	55%					15%	30%	
Perennial Rye	*Lolium perenne*					<5%	5%		
Red-osier Dogwood	*Cornus stolonifera*						5%		
Reed Canary Grass*	*Phalaris arundinacea*		<5%						
Rice Cutgrass	*Leersia oryzoides*		60%					30%	
Stinging Nettle	*Urtica dioica*		5%						
Tall Goldenrod	*Solidago altissima*		5%						
Water Pepper	*Polygonum hydropiper*					20%			
Total % Ground Cover		100%	100%	100%	100%	90%	90%	95%	100%
Average % Ground Cover		97%							

* Denotes invasive species.

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Former Plainwell Impoundment TCRA
Former Plainwell Impoundment 2010 Bank Conditions Monitoring Report

Table 3-3 - Herbaceous Ground Cover in Sample Plots of Removal Area 13B

Observed Vegetation		% Cover				
Common Name	**Scientific Name**	**Plot 1**	**Plot 2**	**Plot 3**	**Plot 4**	**Plot 5**
Bee Balm	*Monarda didyma*	5%	10%		10%	
Black Eyed Susan	*Rudbeckia hirta*	60%	40%	60%	50%	45%
Canada Thistle	*Cirsium arvense*					15%
Canada Wild Rye	*Elymus canadensis*	30%	<5%	5%		5%
Common Plantain	*Plantago major*	5%				
Common Ragweed	*Ambrosia artemisiifolia*			<5%		
Curled dock	*Rumex crispus*		5%			
Daisy Fleabane	*Erigeron annuus*					15%
Field Thistle	*Sonchus arvensis*				40%	
Lance-leaved Coreopsis	*Coreopsis lanceolata*		25%	25%		15%
Perennial Rye	*Lolium perenne*		5%	5%		
Reed Canary Grass*	*Phalaris arundinacea*		5%			
Tall Coneflower	*Rudbeckia laciniata*		10%	5%		
Total % Ground Cover		100%	100%	100%	100%	95%
Average % Ground Cover		99%				

* Denotes invasive species.